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> " To the solid ground
> Of Nature trusts the mind that builds for aye."—Wordsworth.

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Of Nature trusts the mind that builds for aye."—WORDSWORTH.

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Progress and Scientific Method

AMONG the misfortunes of this present age are the tendencies of the Press to seize on the sensational in the business of science, and of the public to expect such sensational pronouncements. This, equally with the absence of an adequate scientific element in our general educational system, of which the first is indeed a consequence, is mainly responsible for the general failure to understand the scientific spirit and the place of science in our civilisation.

Unquestionably, extravagant claims have been made alike regarding the contribution of science to general welfare and the part which men of science have to play in the State and in the general life of the community, and such claims have done great disservice to the cause of science. The evidence, however, does not indicate that in the main such claims have emanated from scientific workers themselves. They have more frequently been due to the journalistic quest for the sensational, to the quotation of impressive passages in the utterances of a man of science apart from the qualifying context. Of this danger the treatment recently accorded to a scholarly address by Prof. A. Findlay to a joint meeting of the Manchester chemical societies is a pertinent illustration. Under the headlines of "A Rebuke to Scientists" it is hard to recognise the thought-provoking address of Prof. Findlay with its wide sweep and philosophic temper, recalling at times the presidential address of General Smuts to the British Association in 1931. Prof. Findlay stressed the idealistic value of science rather than its material results and suggested that the real claim of science to a wider recognition and cultivation in the community is based on such values. The spirit of science, as expressed in the quest for truth, is an essential element complementary to beauty and goodness in the perfecting of humanity, and its inculcation should form an essential element in our system of education.

This plea for science as an essential element of culture and not as part of a technical training was, however, ignored by those who fastened on his refutation of the claims of scientific workers to a privileged position in national administration. Unfortunately, Prof. Findlay himself made one or two incautious remarks which have tended to offset his admirable presentation of a point of view which scientific workers themselves have often been prone to overlook, owing to the widespread neglect of the teaching of the philosophy of science or the scientific outlook in the universities. Few scientific workers with any experience of industry would, for example, care to endorse the statement that, so far as industry is concerned, the battle for scientific control is already won. The position of the Cotton Industry Research Association in the very city in which the lecture was delivered should have been sufficient reminder of how very far we are yet from a general acceptance by industry of the importance of research as an essential element in industrial efficiency and advance. Similarly, so far as national administration is concerned, without pointing to a host of matters in which the neglect of technical factors and scientific opinion has been conspicuous, it is sufficient to recall that the report of the Bridgeman Committee on the Post Office issued recently was the first public inquiry committee to give full recognition to the scientific expert in the Civil Service scheme of things. Only in this report was it recognised officially that the scientific expert is entitled to participate on level terms with the administrative expert and the financial expert in the formulation of policy.

If the principle has been conceded, the application here and elsewhere has yet to be worked out, and those who most welcome Prof. Findlay's insistence on the cultural value of science will most regret his untoward suggestions regarding the capability of men of science for administrative work or the extent to which they have been accepted in such positions. While Prof. Findlay's protest against the mechanisation of industry and his warning against the dangers of materialism and an excessive emphasis on mechanical efficiency will be warmly welcomed, the influence of science on industry has scarcely been either so materialistic or so mechanising as he implies. On the contrary, the application of scientific methods of management characteristic of large-scale industry pays an attention to the human factor which was formerly rarely encountered. The results which have attended the investigations of the National Institute of Industrial Psychology or of the Industrial Health Research Board already attest the humanising effect which applied science can exert on industrial conditions. Moreover, the increasing attention which is being directed to the theory of management has already emphasised the importance to efficient administration of encouraging the development of individual responsibility, the expression of personality and the organisation of the team spirit.

It is indeed here that Prof. Findlay's address is most open to criticism. So far from human nature being intractable to the scientific method, the evidence suggests that one of the most urgent needs of to-day is an adequate attack on the social sciences and a determined attempt to place sociology, economics, psychology on a really scientific basis. Much patient research in anthropology and human biology will be required before this can be achieved, and it is highly probable that the most important contributions of science to human welfare during the next few decades will come from such fields as these, which enable us to understand and interpret more accurately the human factor and our social, economic and industrial problems.

Apart altogether from these considerations, Prof. Findlay's dislike for extravagance has led him to overlook the essential challenge presented by such spokesmen as Sir Alfred Ewing and Prof. Miles Walker. The failure of our present administrative methods to which our economic and international difficulties bear witness, and of which the bankruptcy of the Disarmament Conference is a recent example, had led many others besides men of science to wonder whether methods in which action is determined less by political prejudice than by dispassionate analysis of the ascertained facts may not offer better hope of success. The disposition to accept the leadership of science is prompted by a growing realisation of the extent to which scientific and technical factors enter into all our problems in this scientific age and that, if such factors are only one aspect of our problems, they present an aspect which demands accurate assessment and intelligent action if disaster is to be avoided.

This point of view does not suggest that numerous other considerations are not involved in an administrative decision. It does, however, contend that the scientific worker who possesses administrative ability as well as the capacity to assess the technical facts is at least as likely to arrive at a sound decision, as those without such scientific knowledge and training, and that the openmindedness and willingness to face change associated with the scientific outlook is an important and hopeful element at the present time. The situation is so serious that accepted doctrines in finance, economics, politics are being questioned and must stand their trial as every scientific theory has to do in the advance of science.

Scientific management stands essentially for the substitution of exact scientific knowledge for opinions or rule of thumb methods, and not for the disregard of essential elements in a problem, whether those elements are or are not what is usually described as technical.

Even in industry, such exact scientific knowledge involves to an increasing extent a re-examination of the whole of our economic and indeed of our political machinery and ideas—a re-examination conducted much in the spirit of an engineer faced with a problem in factory or office management and concerned solely with the issue of improving those arrangements so as to secure a higher standard of living for the community. The world believes that the advancement of objective and exact knowledge is inevitable and ultimately beneficial and that the problems of distribution and finance, for example, so long treated in haphazard and fatalistic fashion, will yield to exact knowledge.

It can accordingly scarcely be questioned that in the modern State the scientific expert will occupy a position of increasing responsibility, and the security of our civilisation largely depends upon the efficiency and expedition with which methods are worked out for permitting his effective participation in public as in industrial affairs. Possibly the solution may be found along lines visualised by General Smuts, and the nations learn to look to the organised system of the expert report and accept as a matter of course, just as judicial decisions are accepted, the authoritative and impartial lead which it gives.

An important factor, however, is bound to be the general outlook of the scientific worker himself. His specialist knowledge of one particular field must be joined to a sense of values, a wide outlook and a public spirit which induce him to place his services to a greater extent at the disposal of society. In the leisure State there should be no room for the excessive specialisation and narrowness of outlook deplored by Prof. Findlay, and it should be possible so to re-organise our training that the cultural value of scientific thought and method is imparted to the student, and the tendency of scientific workers to regard only their special field from a scientific point of view counteracted. Only as scientific workers are prepared to regard the whole domain of life from a scientific point of view and to support as a body those who at particular points are seeking to extend the application of scientific method and the scientific spirit, substituting facts for prejudice, opinion or guesswork in determining action, can we hope for decisive advance. Both the organisation and the functioning of the State must become more scientific, impartial, businesslike and less purely political, and the scientific expert is unlikely to receive his fitting place in the new order without organised support from his fellows as well as keen and intelligent criticism.

Prof. Findlay has done well to remind us that science is more than a body of results and truths. Great as are the benefits which mankind has derived from scientific discoveries, from the new knowledge which science has made available, there are greater services to be rendered. Science has yet to teach man how to use that knowledge, to impart generally that attitude, outlook or method of acquiring knowledge which is essential if mankind, individually or collectively, is to adapt himself to the new conditions. Science alone, indeed, will not save mankind from disaster, invaluable as can be its contribution to the fundamental thinking required. But the balanced wisdom and judgment so imperatively demanded to-day can only be attained as science is regarded not as a storehouse of facts to be consulted from time to time but as one of the great human endowments, to be ranked with art and religion, and the guide and expression of man's fearless quest for truth. This outlook can only receive adequate recognition as more and more in their own personality scientific workers exemplify the unifying power of the spirit of science and its contribution to the ordering of every sphere of conduct on a basis of truth and not prejudice.

Properties of the Atom

The Interpretation of the Atom. By Prof. Frederick Soddy. Pp. xviii+355+20 plates. (London: John Murray, 1932.) 21*s.* net.

FEW discoveries, if any, have influenced so rapidly and deeply physics, chemistry and many kindred sciences as that of the spontaneous disintegration of radioactive elements. The development following this discovery attracted also the lay mind, which was struck by the idea of evolution of inorganic matter and by the far-reaching conclusions in the field of geology and cosmology, to which the application of the science of radioactivity led. The layman's interest was enhanced by the spectacular sides like that of electroscopic discharge at the approach of the experimenter carrying radium in his pocket or suitcase, by the radium clock, and, by no means least, by the possibility of the medical application of radium rays against both tedious and fatal diseases.

The general reader interested in the great advances in our knowledge of the nature of matter and its manifold applications has every reason to be highly indebted to Prof. F. Soddy for his "Interpretation of Radium", first published in 1909. It is a most instructive task to compare the above mentioned book with "The Interpretation of the Atom", prepared by Prof. Soddy to take the place of the first mentioned volume, which has long been out of print. Even the reader familiar with atomic physics and chemistry will be struck when reading this account of the unparalleled progress made by these sciences in the last three decades. Part I deals fully and systematically with the remarkable series of spontaneous disintegration of the atom, while in Part II the general progress of atomic chemistry is discussed. A chapter on cognate geological and astronomical aspects and the cosmic radiation concludes the volume.

Prof. Soddy is known as a thinker and writer of unusual originality, who does not hesitate to oppose himself, even to ideas accepted by most of his contemporaries—a characteristic quality which, coupled with genius and lucidity, is undoubtedly responsible for his greatest achievement, the introduction of the conception of isotopes. The reader will therefore not be astonished to find Prof. Soddy in pronounced opposition to the mathematical presentation of physical theories in the age of great successes of quantum mechanics, and to learn that he is not among those who can "bow down and worship the square root of minus one". "The Interpretation of the Atom" is primarily intended for the general reader, but it will undoubtedly prove to be a helpful guide to scientific students of all grades; while the man of science interested in the history of this subject will also find matter of interest to him.

The development of scientific thought and progress often follows roundabout paths, which even the onlooker has difficulty in following; not a few scientific workers are inclined, therefore, to the view that the official history of the development of scientific thought not seldom differs materially from the actual course of events. Two examples may be cited, Bohr's fundamental conception of the atomic structure, and the development of the notion of atomic numbers, both outstanding events in natural philosophy, and the development of which are usually described in a way which differs materially from the actual facts. We mostly read that Bohr's conception was due to the effort to explain the appearance of spectral series. It would go too far to pretend that Bohr (who not long before passed his examination with first class honours) would not know of the existence of spectral series, but these were certainly not in the forefront of his thoughts when he first embarked on the philosophy of the atom. It was only at a later date, that in discussing experimental results obtained by one of his Copenhagen colleagues, he noticed the possibility of applying his new conception to explain the appearance of spectral series.

The actual development was as follows. Bohr was deeply struck by Rutherford's conception of the nuclear atom, realising simultaneously, however, the impossibility of reconciling this conception with the requirements of the classical theory of radiation. The most direct step would have been to discard Rutherford's conception; Bohr chose another path and introduced Planck's quantum idea in place of the classical conception, when interpreting the stability of the nuclear atom. By doing so he was led at once to the fundamental distinction between the nuclear and electronic properties of the atom, to the identity of the atomic number and nuclear charge and also to the conclusion that the emission of the disintegration β-particles has its origin in the nucleus. The latter led him to the conclusion that, for example, when an atom of thorium loses consecutively one α- and two β-particles, the thorium atom reappears, and he arrived thus at the displacement laws, as a special case of a much wider generalisation. Bohr discussed this result widely without publishing it. These laws were, as is well known, published later by different men of science as an empirical summary of the experimental results of Fleck and others. That the sequence of the elements in their natural system, that is, the atomic number, is identical with the number of the nuclear charge, was published by Bohr at an early date when basing his first calculations on the assumption that the hydrogen nucleus has one, the helium nucleus two, elementary charges, and so on.

The above narrative of the introduction of the conception of the atomic number would, however, not be complete without mentioning that this conception emerged, simultaneously with Bohr's deductive line of thought, in the Manchester physics laboratory on inductive lines. Geiger and Marsden checked completely Rutherford's theory of large scattering of α-particles and found the nuclear charge of gold to be about 100. This result was not at all unexpected, as early theories of α-ray scattering and stopping had suggested already that there should be half as many electrons in the atom as its weight. When Moseley started his work which became the foundation of a new and important branch of physics, the conception of atomic number was thus clearly developed. We owe to Moseley's genius a simple method of determining the atomic number of each element and of fixing exactly the number of elements between hydrogen and uranium. From the fact that the nuclear charge of gold was found to be 100, and also from the chemical evidence, it followed already that the number of unknown elements could only be a very restricted one. The actual number was, however, fixed by Moseley.

The introduction of the conception of the atomic number impressed contemporary scientific workers so deeply that its rival conception, that of atomic mass, seemed for a while to be deposed from its long reign. Through Aston's work and the development of later years, contemporary interest is again focused on atomic mass and thus equal rights are secured for these two fundamental properties of the atom.

Every reader interested in the problems and the progress of natural science will find Prof. Soddy's book most fascinating reading. G. HEVESY.

Chromosome Mechanics

(1) *Recent Advances in Cytology.* By Dr. C. D. Darlington. Pp. xviii + 559 + 8 plates. (London: J. and A. Churchill, 1932.) 18*s.*

(2) *Chromosomes and Plant-breeding.* By Dr. C. D. Darlington. Pp. xiv + 112. (London: Macmillan and Co., Ltd., 1932.) 7*s.* 6*d.* net.

THE discovery that the chromosomes are the bearers of the hereditary units (genes) has led to a renewed interest in their study by cytological methods. There has developed a vast literature, much of it based on correlated studies of cytology and experimental genetics. Dr. Darlington has worked through this literature, and has attempted in the larger of the two works under notice not only to describe the more important recent results but also to provide a unified general scheme of chromosome behaviour.

This general scheme is based on several fundamental hypotheses. The first of these is that like chromosomes (or parts of chromosomes) are regularly attracted in pairs, and that the attractive force is satisfied when two like parts come together, so that more than two are not attracted. This leads directly to an interpretation of the difference between mitosis and meiosis. At mitosis each chromosome is already split into two daughter chromatids at prophase. These lie side by side and thus satisfy the attractive force. At meiosis the division is delayed, and attraction therefore causes homologous chromosomes to conjugate. Division now follows, and there result four chromatids instead of two chromosomes; these are no longer attracted except in pairs, and at each level there results a separation into two groups of two chromatids each. Observation shows, however, that this separation does not occur between the same pairs of strands at each level, so that there are chiasmata, or crossed strands, at certain points. Darlington argues that it is these chiasmata that maintain the unity of the quadruple structure until metaphase, and thus insure regular segregation. In the absence of chiasmata the chromosomes merely fall apart into two separate pairs, and these segregate at random at the first division.

According to Darlington, each chiasma results from a crossing over. The initial separation of two chromatids from two others is reductional at every level, that is, the two chromatids derived by division of a single chromosome always remain associated. If two that are not sisters have undergone mutual exchange at a given level, there results a chiasma at that level.

These are Darlington's main theses; meiosis is mitosis with delayed division of the chromosomes, chiasmata result from crossing over, and metaphase pairing is due to chiasmata that prevent separation of divided homologues. He interprets the whole range of chromosome cytology and genetics on the basis of these views. There is a logical and detailed marshalling of an almost overwhelming body of evidence, much of it based on Darlington's own novel and extensive investigations. This evidence relates not only to careful analysis of the normal behaviour of a very wide variety of animals and plants, but also more especially to unusual cases—polyploids, extra-chromosome types, hybrids, and mutant differences in chromosome behaviour.

The reviewer finds himself strongly inclined in favour of two of the main hypotheses—those concerning the nature of meiosis and the effect of the chiasmata in holding homologues together until metaphase. The first of these is contrary to the observations of some cytologists, who have reported that the chromosomes divide before the meiotic conjugation; but Darlington's view has an attractive logical simplicity that makes it difficult to think of the phenomena in any other terms. Acceptance of these hypotheses involves also acceptance of the more fundamental hypothesis of attraction by twos and not by larger numbers. But it does not necessitate acceptance of Darlington's interpretation of the origin of chiasmata. This hypothesis leads to certain contradictions with the genetic data, which to the reviewer seem fatal to the hypothesis. The occurrence of regular pairing in the male *Drosophila*, in which there is no crossing over, makes it clear that chiasmata are not necessarily associated with crossing over—a conclusion avoided by Darlington only by the expedient of very special and improbable accessory hypotheses. It follows that chiasmata are not due to crossing over, and one may turn to the alternative view, referred to by Darlington as the "classical hypothesis". On this interpretation the initial separation is not always reductional, that is, at certain levels sister chromatids separate. If the separation is in different planes at successive levels, a chiasma will result between these levels. If the initial separations are permanent, crossing over will result (after, not before, the chiasma is formed), but it is possible that, at times, the original separation plane may be only temporary, the chiasmata simply unravelling without leading to crossing over. On such a basis it appears to be possible to give a self-consistent account of the genetic and cytological phenomena.

Evolutionary discussions occupy much space in Darlington's book. His view is that chromosomes are especially favourable for the construction of evolutionary schemes, because their materials control the gross structure of the organism but are not themselves controlled by the rest of the organism, and for several other reasons. The discussion of the evolution of chromosomes and chromosome systems is interesting and at times stimulating; but to one who has studied the period in the history of zoology when the making of hypothetical phylogenies was popular, there is a familiar sound to the argument. There are many who will hope that we are not to see a revival of the fashion of constructing elaborate hypothetical histories that must for ever remain hypothetical.

This is a difficult book. It is closely argued, and so full of facts and ideas as to require slow and careful reading. It will be indispensable for the student of cytology or genetics, but the more general reader will find the smaller book easier to assimilate. This, as its title indicates, is written for the plant breeder; but anyone interested in the new results obtained by the cytological study of polyploid and hybrid plants will find here an admirable and readable summary.

A. H. STURTEVANT.

Modern Physic

(1) *The British Pharmacopœia, 1932.* Published under the direction of the General Council of Medical Education and Registration of the United Kingdom. Pp. 1 + 713. (London: Published for the General Medical Council by Constable and Co., Ltd., 1932.) 18*s.* 6*d.* net.

(2) *The Extra Pharmacopœia of Martindale and Westcott.* Revised by Dr. W. Harrison Martindale. Twentieth edition. In 2 vols. Vol. 1. Pp. xlviii + 1216. (London: H. K. Lewis and Co., Ltd., 1932.) 27*s.* 6*d.* net.

(1) THE duty of preparing "The British Pharmacopœia" was laid upon the General Medical Council by the Medical Act of 1858 and the Medical Council Act of 1862. Since then five pharmacopœias have been issued at irregular intervals varying from three to eighteen years. The present issue is the sixth and in future

revision will take place every ten years. It is explained in the preface that the "Pharmacopœia" includes only the more important "standard articles, which are in use throughout the Empire" and with characteristic British elasticity in governance, provision is made for the issue of supplements or addenda by Governments of overseas parts of the Empire, who may desire to sanction the use of drugs with a local reputation. This is a happy solution of a long-standing difficulty.

The Commission upon which the actual work of preparing the "Pharmacopœia" devolved, was assisted in its labours by a group of sub-committees on clinical medicine, pharmacy, pharmacology, pharmacognosy and pharmaceutical chemistry, whilst the decision for or against biological standards for ergot, cod liver oil, digitalis and strophanthus, arsenobenzene derivatives and similar products, chemical control of which is still doubtful or impossible, necessitated the appointment of eight subsidiary committees, one for each subject of potential biological standardisation.

The revision of a pharmacopœia involves three branches of work, the elimination of drugs which have become redundant or obsolete, the selection of such recent contributions to *materia medica* as have found a sure footing in clinical medicine, and the definition of each item in the final list. In the new "Pharmacopœia" the omissions are far more numerous than the additions. They are chiefly galenical preparations, some of which are replaced by more modern examples of the pharmacist's art, some crude vegetable drugs, a number of compounded medicines and a few synthetic, pharmaceutical chemicals. No serious objection can be raised to any of these omissions, especially as the articles concerned will still figure in the British Pharmaceutical Codex, the revision of which is now in progress. Indeed this process of elimination might have been carried further. Eucalyptus oil (cineole, 70 or more per cent), cajuput oil (cineole, 50 to 60 per cent) and eucalyptol (cineole, 97·5 per cent) are presumably all included for the sake of their cineole content, this being the component indicated by the prescribed assay, and if so, two of them are redundant.

The additions include several well-known alkaloids, quinidine, ephedrine, ergotoxine and emetine, which have found new and important medicinal applications since 1914, a number of synthetic drugs, including a choice of local anæsthetics, and hypnotics and the indispensable antisyphilitics, neoarsphenamine and sulpharsphenamine. The most notable addition is the group of biological products including insulin, liver extract, Schick control, Schick test toxin, diphtheria prophylactic, antityphoid-paratyphoid vaccine, gas-gangrene antitoxin, and antidysentery serum. Apart from this biological innovation, it cannot be said that any striking change has been made in the list of officially recognised drugs. Some notable candidates for recognition have probably been omitted because they are patented products, others because their present reputation may be based on pioneering enthusiasm and they have still to run the gauntlet of extended clinical trial, which will eventually bring them to their proper places in practical therapeutics.

The list of official drugs, which emerges by the operation of these two kinds of selection, is essentially a matter for comment by clinicians, but if a chemist may venture two opinions upon it they are, that the list is what a list of officially-recognised drugs should be—safe, sound, and not too conservative—and that it is satisfactory because due weight has been given to the pharmacological and chemical evidence for and against each drug.

It is in the third branch of its labours, the definition of the selected products, that the Commission has most clearly improved upon preceding pharmacopœias. Much more attention is given to tests for identity and for degree of purity, to the analysis of chemicals and to the assay of potent galenical and biological preparations. In the 1914 Pharmacopœia the appendices amounted to over eighty pages: in the new issue nearly twice that space is occupied, due mainly to the inclusion of more descriptions of biological, chemical and physical methods for the determination of the quality of drugs, using that term in a broad sense. These appendices now form a useful and interesting manual of methods of assay, which may even find a place for the Pharmacopœia in laboratories not directly concerned with medicinal products.

Daily use of the sixth" British Pharmacopœia" will inevitably reveal minor weaknesses, but taken as a whole it is a satisfactory and in many ways a model contribution to the world's collection of national pharmacopœias. The nation has every reason to be grateful for the labours of the Pharmacopœia Commission, for the time and knowledge which the committees of experts have expended and for the accumulated results of technical experience which manufacturers have given just as freely. The least it can do in return is to provide for that continuity of investigation which will lighten the work of preparing the Pharmacopœias of the future.

(2) When a technical work has reached its twentieth edition in the course of less than half a century, it may be assumed that the author knows much better than any merely ephemeral reviewer, what his particular public requires and in what form to give it to them. This is the case of the "Extra Pharmacopœia". The book is fittingly noticed here because it provides the medical practitioner with the information he needs about the latest developments in therapeutics and thus facilitates that extensive clinical experimentation with new *materia medica*, the results of which alone can finally determine their real value. It thus serves the cause of medical progress and at the same time admirably fulfils its main purpose as a handy and singularly complete reference book for the multifarious needs of the pharmacist and the medical man. In these respects the twentieth edition is as good and as up to date as its predecessors were in their day, and those who know the "Extra Pharmacopœia" need no further commendation. T. A. H.

Short Reviews

The Outline Series. *The Physical Nature of the Universe.* By J. W. N. Sullivan. Pp. 143. *Theories and Forms of Political Organisation.* By G. D. H. Cole. Pp. 160. *Modern Theories and Forms of Industrial Organisation.* By G. D. H. Cole. Pp. 159. *An Introduction to the Study of Sex.* By Prof. F. A. E. Crew. Pp. 160. *An Introduction to Psychology.* By Prof. F. Aveling. Pp. 176. *An Introduction to Finance.* By Prof. T. E. Gregory. Pp. 144. *An Introduction to Economics.* By Maurice Dobb. Pp. 143. *The Arts of Painting and Sculpture.* By Roger Fry. Pp. 160. *An Introduction to Psycho-Analysis.* By Prof. J. C. Flügel. Pp. 159. *The Theory and Practice of Architecture.* By Prof. C. H. Reilly. Pp. 144. *Principles of Literary Criticism.* By Prof. Lascelles Abercrombie. Pp. 160. (London: Victor Gollancz, Ltd., 1932.) 1*s.* 6*d.* each.

ONE of the more hopeful signs, indicating the approach of an age in which knowledge and power are more closely and harmoniously related, is the reception afforded to the various summaries or outlines of modern knowledge which have appeared in recent years. The publication in separate parts of eleven of the essays by acknowledged authorities which formerly appeared as a composite book under the title "An Outline of Modern Knowledge" is evidence of this demand and the publishers are to be congratulated on the step they have taken in place of issuing a new edition of the composite work.

The publication as individual essays is free from several objections which may be brought against the combined treatise. The essays can be seen as the introductory monographs which they really are and the impression of a reference book is destroyed. The lack of proportion in the original book is less conspicuous in the separated monographs and could indeed easily be remedied by the publication of supplementary volumes to fill the more serious gaps, so far as they are not found in the reprinted monographs themselves.

Handbuch der Pflanzenanalyse. Herausgegeben von G. Klein. Band 2: *Spezielle Analyse.* Teil 1: *Anorganische Stoffe; Organische Stoffe, I.* Pp. xi + 973. (Wien: Julius Springer, 1932.) 99 gold marks.

A KNOWLEDGE of the constituents of plants is becoming both of increasing importance and difficulty, as their number continues to grow, and it is, therefore, of value to have a work of reference which, on one hand, lists the various products according to some logical scheme, whilst on the other, it describes the methods for their identification and analysis. Working in conjunction with the index of nearly ninety pages, it is possible rapidly to have the requisite information about any desired compound.

The book is necessarily the result of collaboration, no less than twenty-three different authorities being responsible for the several sections. The first quarter of it deals with the inorganic constituents of plants including the nitrogen compounds, also the analysis of plant ash and gas: it is done with great attention to detail but in a suitably concentrated form. There follows the organic section divided up into groups of allied substances as is customary: it is this part which will be found of immense value to all active workers in the domain of plant chemistry.

The matter is highly condensed but contains just the information which is usually needed, and the text is not overburdened with countless references to the original literature, which the seeker must find in certain other works indicated, should he require them. Taking the section headed "Phenols" for example: the systematic occurrence in indicated plants is given for 61 phenols, 10 quinones, 11 anthraquinones. The general properties and colour reactions of phenols are described with a note as to the properties and derivatives of each individual phenol, the whole giving the complete state of knowledge in this particular field, which it would otherwise take a great deal of reading to survey.

Climate: a Handbook for Business Men, Students and Travellers. By Dr. C. E. P. Brooks. Second edition, revised. Pp. 199. (London: Ernest Benn, Ltd., 1932.) 10*s.* 6*d.* net.

AN early second edition testifies to the general utility of Dr. Brooks's handbook. All parts of the globe are dealt with, and a useful feature at the end of each regional division is a table furnishing for a number of selected places data of temperature, humidity, rain, snow and thunder. There are very few illustrations, and, perhaps, it is a recommendation that the book is not encumbered by a lot of commonplace maps and diagrams.

The treatment is essentially statistical, but Dr. Brooks knows his subject too well to allow his outlook to be blinded by the data which he wields. This is an important matter because climatology as a science has suffered badly from the mishandling or misinterpretation of the very data on which it largely depends.

The book is, however, not so free from loose statements as is to be expected in a second edition. For example, a statement, to the effect that it is the relative humidity which gives the 'feel' of the air, seems to us to be faulty. The 'feel' of the atmosphere is an intricate complex of temperature, wind, radiation, moisture and probably, also, obscure influences like electricity; but, so far as humidity is concerned, it is surely the absolute humidity or vapour pressure as controlling the rate of evaporation from the body which is the important factor, not the relative humidity except at saturation point with fog. Thus on an enervating summer day of high vapour pressure the relative humidity is often much lower than on a bracing winter day of low vapour pressure. L. C. W. B.

Faith, Hope and Charity in Primitive Religion. By R. R. Marett. Pp. vii+181. (Oxford: Clarendon Press; London: Oxford University Press, 1932.) 10*s.* net.

DR. MARETT'S Gifford lectures for 1931–32, an expanded form of lectures delivered under the auspices of the Lowell Institute of Boston in the previous year, have as their theme the evaluation of the religious experiences of peoples of the lower culture, or as Dr. Marett prefers to call them, savages. It must not be thought, however, that Dr. Marett would regard anthropology as one of the normative sciences and that he would attempt to apply an ethical scale to primitive ideas of behaviour. His evaluation is biological in the sense that its aim is to test survival value. The various activities of the savage are passed in review one by one and analysed with the view of the isolation of their emotional content—savage religion being a matter of the emotions rather than of intellect or of action. Dr. Marett then proceeds to show that the religious emotions which colour the whole range of savage activity on the whole make for the virtues or qualities which he designates "Faith, Hope and Charity" and regards as the effective element in the contribution of religion to the advancement and survival of man. A brief summary does less than justice to the acuity of Dr. Marett's vision—it may be suspected that at times he finds his material a thought intractable. Nor is it possible to do more than refer to the insight shown in the many valuable suggestions on controversial points which he throws off, almost casually, in the course of his argument.

Thermionic Vacuum Tubes and their Applications. By Prof. E. V. Appleton. (Methuen's Monographs on Physical Subjects.) Pp. vii+117. (London: Methuen and Co., Ltd., 1932.) 3*s.* net.

THE student with a good knowledge of general physics will find this volume very helpful in studying radio-frequency phenomena. Modern thermionic tubes have so many important applications in physics and electrical communication that a knowledge of their action and how they are constructed is essential to almost every research physicist and electrical engineer. The author writes carefully and clearly, so the ordinary reader easily grasps the laws which govern the emission of electricity from hot bodies and how to apply Richardson's formulæ to make calculations. He then explains the internal action of the two electrode tube (diode) and states some of its applications. Finally he discusses the three electrode tube (triode) and describes its applications as an amplifier, a rectifier and an oscillation generator. The book can be recommended to the experienced amateur in radio communication as a scientific introduction to the subject as well as to the physicist and mathematician who intend to read the relevant parts of advanced treatises well before following up some line of research.

The Practical Treatment of Diabetes. By Dr. T. Izod Bennett. Pp. ix+107. (London: Constable and Co., Ltd., 1931.) 6*s.* net.

THIS book is a brief and severely practical account of the modern method of treating the diabetic. References to theory are few and are limited to such details as are absolutely necessary to explain the therapeutic steps. A short chapter is devoted to diagnosis, the second and third to general principles of treatment and dieting, the fourth to the use of insulin, and the remainder of the book to complications and special problems and considerations. As described by Dr. Izod Bennett, the restoration of a diabetic to such condition that he is sugar-free on sufficient diet appears an easy matter, and the general practitioner who has not had to deal with many cases will learn with surprise that this object can be attained almost invariably within three weeks. How it can be done is clearly set out in some fifty pages of this book, which, as a practical guide, lacks no essential features. Specimen diets during treatment, and food tables showing the great variety finally available, are included.

Mount Everest

By Col. H. L. CROSTHWAIT, C.I.E.

MOUNT EVEREST, everyone knows, is the highest mountain in the world. It was discovered, and its height determined, during the operations of the Great Trigonometrical Survey of India in the course of carrying out the geodetic triangulation of that country in the years 1849–50. The figure adopted, namely, 29,002 ft. above mean sea level, was derived from the mean of a large number of vertical angles observed to the peak from six different stations situated in the plains of India south of Nepal. These stations were at distances varying from 108 to 118 miles. It was not until some months afterwards, when the necessary computations had been completed, that the great height of Everest was first realised. The actual discovery was made in the computing office at Dehra Dun.

The determination of height above mean sea level by the method of vertical angles, observed from one station only, involves the assumption of a coefficient of refraction—always a doubtful quantity, especially where great differences of height are concerned as in the present case—and also a knowledge of the amount of separation of the geoid and the sphereoid. Suffice it to say, however, that the subsequent extension of observations to the mountain so as to include stations situated within the hills, and the adoption of a more probable coefficient of refraction, made the summit some 29,149 ft., but the estimated separation of the geoid and sphereoid, due to deformation caused by local attraction, would reduce this amount, the net result being to assign to the peak a probable height of about 29,050 ft. above mean sea level. There are also certain other corrections which can be estimated theoretically but these are not taken into account in ordinary trigonometrical levelling.

By height above mean sea level is implied the distance of the summit above the geoid immediately beneath it. Accepting this definition, it is not possible to determine accurately the height when access cannot be had to the summit for purposes of observation. Taking into account that there are still doubtful quantities involved, it has been considered best to allow the time honoured figure of 29,002 ft. to stand, anyhow until sufficient data are available to enable a more exact solution of the problem.

It may be asked why so little was known about the highest mountain in the world beyond its position and height, until comparatively recently, considering it was discovered eighty-two years ago. This was, without doubt, due to its great distance from civilisation and above all to the strict political isolation maintained by the two countries, Nepal and Tibet, on the border of which it is situated. The shortest way, some 110 miles, to reach the mountain from India would be through Nepal, but even if the Nepalese Government were willing to permit the passage of its country, the route would be through trackless leach-infested jungles impossible for pack transport. Added to this, the snow line is about 2,000 ft. lower on the south side than on the north, for it is subject to the full force of the monsoon and is probably more deeply eroded and, in consequence, more inaccessible than from the Tibet side. For these reasons successive expeditions have taken the longer route, about 350 miles from Darjeeling via the Chumbi valley, Kampa Dzong and Sheka Dzong, made possible since the Tibetan objection to traversing its territory has been overcome.

This route possessed the advantage of passing through country where pack transport was available, and could be used up to the base camp. Further, it lies at an average elevation of about 14,500 ft., so the long march has a certain beneficial effect in acclimatising the party before the base of operations is reached.

Though the project to climb Mount Everest had been long in the minds of several mountaineers, the first definite move in the matter appears to have been due to Major Rawling and Captain Noel, about the year 1912–13. Both these officers had had experience of Tibetan travel. Then followed the years of the War in which Rawling was killed. The project was revived in 1920, when permission was obtained from the Tibetan Government to approach the mountain through its country. A Committee, consisting of three members each of the Royal Geographical Society and the Alpine Club, was formed to collect funds, select personnel, purchase instruments and equipment and generally to manage the business of an expedition to Everest. The chairman of this Committee was Sir Francis Younghusband.

There have now been three expeditions including the one in 1921, which was of the nature of a reconnaissance. The other two were serious attempts to reach the summit—they were undertaken in the years 1922 and 1924. As already announced, a fourth expedition will leave England early this year.

The expedition of 1921, led by Col. C. K. Howard-Bury, consisted of Dr. A. M. Kellas, C. Raeburn, G. H. L. Mallory, G. H. Bullock, mountaineers, and A. F. R. Wollaston, doctor and naturalist. Since the local topography of the mountain and its neighbourhood was quite unknown, Majors Morshead and Wheeler, of the Survey of India, with three Indian surveyors, and Dr. Heron, of the Indian Geological Survey, joined the expedition in India. Unfortunately, that veteran mountaineer, Dr. Kellas, died at Kampa Dzong on the way out.

The party started from Darjeeling on May 18 and after the long detour through Tibet, already mentioned, reached Tingri, a place about 45 miles north-north-west of Everest, a month later. On June 23, Mallory and Bullock began the exploration of the western and northern sections of Everest. Approach was soon found to be, if not impossible at least very difficult, from the west and north-west. They then turned their attention to the great Rongbuk Glacier which drains the northern slopes of the mountain. It was seen to consist of at least two important branches—one trending away to the west, and the main glacier coming down from the northern face of Everest itself.

As the result of these explorations the following facts were established, that the key of the mountain appeared to be an important saddle, the Chang La (North Col), 22,990 ft., situated at the head of the main Rongbuk Glacier, about 1¾ miles from the summit of Everest, and that it could only be reached with the greatest difficulty from the main glacier. It then became necessary to seek another way of approach to the Chang La. They decided to try what could be done from an easterly direction. They therefore marched round to a new base which, in the meantime, Howard-Bury had established in the Kharta Valley, at the head of which lies the Hlakpa La (22,200 ft.). This point they eventually reached in the face of very adverse weather. It was found to lead to a hitherto unsuspected eastern branch of the Rongbuk glacier, draining into the main valley through a narrow gorge, which had been missed during the first reconnaissance. Mallory, Bullock and Wheeler crossed the East Rongbuk glacier and succeeded in reaching the summit of the Chang La itself on September 24. In doing this they had the most difficult climb, especially for laden men, that had so far been encountered. "Beyond the Col (Chang La) an easy succession of rock and snow slopes could be seen leading to the north-east shoulder (27,390) of Everest."

The weather and the exhaustion of the party prevented any further advance. This closed the season of 1921. The results may be briefly stated. A practical route had been discovered, via the Chang La, which had been reached from the Kharta valley, but there was an easier way by the East Rongbuk glacier which avoided the ascent of the Hlakpa La and consequent descent of about 1,200 ft. in order to reach the foot of the Chang La. The best time for high climbing appeared to be the months of May and early June.

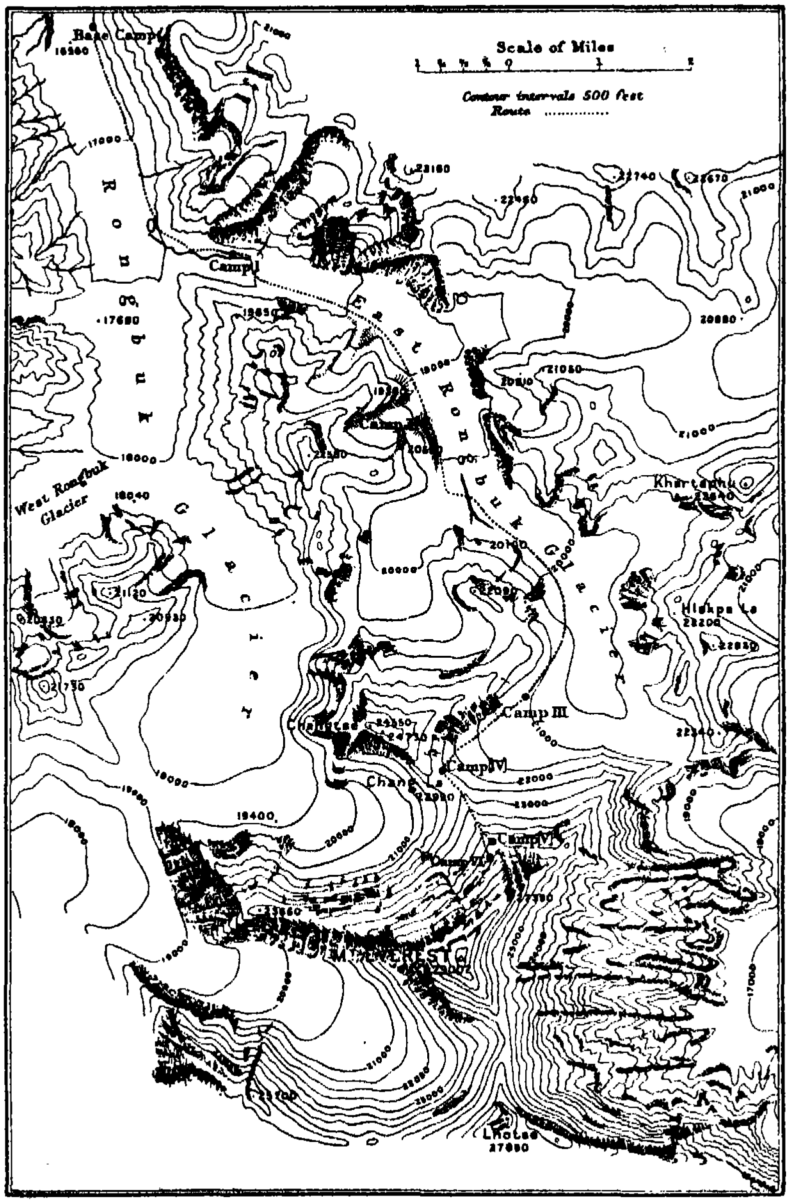

FIG. 1.—Everest and the surrounding country. By courtesy of the Royal Geographical Society

In the course of this reconnaissance, 600 square miles in the immediate neighbourhood of Mt. Everest were mapped photographically on the 1-inch scale, which proved of great use in subsequent expeditions.

A way had now been found to make a real attempt to reach the summit. The expedition of 1922 comprised Brig. Gen. the Hon. C. G. Bruce, as leader, Col. E. L. Strutt, as second-in-command, Mallory, T. H. Somervell, Dr. T. H. Wakefield, Prof. G. I. Finch, Major (now Brigadier) E. F. Norton, mountaineers, Dr. T. G. Longstaff, doctor and naturalist, J. B. L. Noel, photographic and cinema expert. In India the party was joined by the late Lieut.-Col. H. T. Morshead, C. G. Crawford, Capts. Morris and G. Bruce.

One of the questions which the Mount Everest Committee had to consider was the use of oxygen for climbing the last stages of the mountain, which appeared to offer no great difficulty apart from lack of oxygen inseparable from great altitude. It is a matter on which climbers and physiologists are not agreed. Some are in favour of relying on the acclimatisation of those men selected for the final assault. This means remaining for some time at high altitudes under what, at best, must be very trying conditions, where deterioration may set in from the lack of well cooked food and exposure to great cold. The disadvantages of oxygen were the considerable weight of the apparatus, about 30 lb., which the climber himself would have to carry, and the number of porters required to take up the supply of spare cylinders in which the gas is compressed to 120 atmospheres. Then there was the danger of the apparatus going wrong at the critical moment. After taking into consideration all the arguments for and against, "the Committee finally unanimously agreed" to its use.

Profiting by the experience of the previous year, the expedition left Darjeeling on March 26, 1922, following the same route as the year before to Sheka Dzong where they turned south, reaching the spot selected for the Base Camp at the snout of the Rongbuk glacier, 16,560 ft., at the end of April. By May 20 camps were established up to Camp IV as shown on the accompanying sketch map. Camp III at a height of 21,000 ft. at the foot of Chang La on rock, Camp IV on the Chang La, on snow, just under 23,000 ft. What they had now "to aim at was getting two tiny tents carried up the North Face to some niche near the North-East Ridge at a height of 27,000 ft.", that is somewhere above the position of Camp VI on the map, and 2,000 ft. from the top. From such a point it was hoped the final assault on the summit could be successfully made. "So the crux of the situation was the capacity of porters to carry two tents and sleeping bags, provisions and light cooking apparatus for this 27,000 ft. camp" sufficient for four climbers. This arduous work was to be carried out by a specially selected corps of forty Nepalese porters.

The first assault was made on the morning of May 20 from Camp IV, where four climbers—Mallory, Somervell, Norton and Morshead—had slept the night before, but they were only able to reach Camp V, 25,000 ft., and had to spend the night there. The next day was fine and they succeeded in reaching a height of 26,985 ft. just below the north-east shoulder of Everest (marked 27,390 ft. on the map). They were "within one mile of the summit and there appeared to be no serious obstacle in this last remaining lap—only it was more than could be accomplished in one day from a camp at 25,000 ft." They were compelled to turn back on account of the slow progress made and the lateness of the hour. It was between 10 and 11 P.M. before the party reached the shelter of Camp IV on the Chang La. All four were more or less frost bitten during the descent. The worst case was Morshead, who afterwards had to have the top joint of three of his fingers amputated.

Finch, G. Bruce, and the Gurkha Lance-Corporal Tejbir, then made another attempt, this time using oxygen. They were accompanied from Camp IV by twelve porters carrying spare oxygen cylinders and camp gear. The climbers themselves carried the oxygen apparatus weighing about 30 lb. They hoped to pitch a camp at 26,000 ft., but they only succeeded in reaching 25,500 ft. when they were forced by the weather to camp and send the porters back to Chang La. For thirty-six hours the storm lasted, and there was great danger of the whole camp being blown away. On the third day, still using the remaining oxygen, they reached a height of 27,235 ft., about half a mile from the top, when they were compelled to return.

One more attempt was made early in June by Mallory, Somervell and Crawford, but an avalanche, on the steep ascent to the Chang La, carried away seven of the porters, who were killed instantaneously. The monsoon had now arrived and all further attempts for the season were abandoned.

The results of the 1922 expedition were—heights of 27,235 ft. and 26,985 ft. were reached with and without oxygen; it was ascertained that there are no serious physical obstacles between the highest point attained and the summit. Camps were made at 25,000 ft. and 25,500 ft., but it was found that it was not possible from there to reach the top and return in one day. Oxygen was used for the first time, though its efficacy does not appear to have been definitely proved or disproved.

We now come to the third expedition, which was undertaken in 1924. This year Gen. Bruce was again the leader, but owing to illness he was obliged, shortly after the start, to hand over to Col. Norton who had been appointed second-in-command. The other members were Mallory, Somervell, G. Bruce, Odell, Beetham, Hazard, Irvine, Shebbear, Major R. W. G. Hingston, and Noel who was in charge of the photographic equipment which was to contribute so much to the finances of the expedition.

Darjeeling was left on March 25, the old Base Camp at the foot of the Rongbuk glacier being reached on April 29. The three camps in the glacier valley had then to be established and stocked, and the route to Camp IV on the Chang La made practicable for laden porters. This done, Camp V, 25,500 ft., would have to be similarly established and stocked and finally

Camp VI, at 26,500 ft., and possibly another camp (not marked on the map) at about 27,200 ft. "All this had to be done before the actual attempt could be made."

Camps I and II were established and stocked with Tibetan labour, while all above this were worked by the specially enlisted Nepalese porter corps, fifty-two strong. Early in these operations the occurrence of violent winds and snow impeded the work, obliterating the way which had been prepared a short time before. On the night of May 6–7, the thermometer fell to 21½° F. below zero. There were many sick porters at Camp III who had to be sent down to Camp II. In these circumstances it was not easy to keep up the morale of the porter corps. This first attempt got no further than Camp III. It was beaten by the weather and in the end the whole expedition had to retreat to the Base Camp; even this was only carried out with considerable difficulty. "So ended Round One with the mountain."

After a complete reorganisation of the porter corps a fresh start was made on May 17. By May 19 the expedition was in full occupation up to Camp III. The next operation was to tackle the route to Camp IV, which has already been mentioned as the most difficult obstacle. It was here that the seven porters lost their lives in 1922, so the greatest care had to be taken to guard against a similar accident, by finding a way clear of avalanches. This was found by Norton, Mallory and Odell. It proved to be a most exhausting operation, accompanied by several narrow escapes, especially for Mallory, who nearly lost his life by a fall into a crevasse. The establishment of Camp IV was undertaken by Somervell, Hazard and Irvine, using the way marked out by Norton and Mallory. Ropes were fixed at the worst places and a rope ladder was used for negotiating the chimney. Then came the rescue by Norton, Mallory and Somervell of four porters stranded at Camp IV. Incidents like this are most trying and exhausting for members of the climbing party just before they have to make the supreme effort to reach the summit, yet such occurrences cannot be avoided.

The next effort was made by Norton and Somervell with the help of three gallant porters. They pitched a tent at Camp VI, 26,800 ft., and sent the porters back to the Chang La. The night was spent at this height and they slept fairly well. The next morning, June 4, they started at 6.45 for the summit which was about a mile off and 2,200 ft. above them. The going was good, the day perfect. At 27,500 ft. they both began to feel symptoms of distress. Norton felt very cold and had trouble with his eyes; Somervell also was in trouble with his throat and had to stop often and cough. "Now seven, eight or ten complete respirations were necessary for each single step forward." They struggled on, however, to about 28,000 ft., when Somervell could go no further. Norton went on to 28,126 ft., when his progress became very slow. It was then 1 P.M. when he, too, was forced to give up. The cause of their failure was most likely due to want of fitness following the strenuous time they, with other climbers, went through in rescuing the marooned porters, and other exertions which should be avoided if the final climb is to be successful.

The last and final attempt was now to be made. Two climbers without oxygen had failed. It was the turn of others to try with oxygen: Mallory, the experienced mountaineer whose third expedition it was to Everest, and Irvine, the young undergraduate and Oxford blue. On June 7 they set out for Camp VI while Odell was in support at Camp V. On arrival Mallory returned his four porters to Odell and he and Irvine spent the night at Camp VI. In a note which he sent back with the porters to Odell he said, "the weather was perfect but the oxygen apparatus was a nasty load for climbing."

Nothing is known of what happened after this except that Odell saw them at 12.50 P.M. the next day much nearer their camp than he had expected they would be had they started early in the morning. Shortly afterwards the mist shut out the view and Odell saw them no more. That evening Odell returned to Camp IV, where Hazard was. The following day, as the climbers did not return, Odell, with two porters, reascended the mountain intending to visit Camp V and VI, but did not get further than Camp V, where he spent the night. The following morning the weather had changed, a strong and bitter wind was blowing. As he could not persuade the porters to go any higher he sent them back to Camp IV, going on himself alone to Camp VI. This time he took oxygen, though he does not seem to have derived much benefit from it. He eventually reached Camp VI but found no sign of Mallory and Irvine. After searching in vain further up the mountain for a couple of hours, he too was obliged to return. In a storm of gale force he reached Camp IV; it was evidently a forerunner of the approaching monsoon. Here Hazard was awaiting him. Next day they evacuated the Chang La camp. Thus ended the last assault on Mount Everest.

A great adventure deserves a great narrative. The story of Mount Everest has been told in three large volumes splendidly illustrated by the leaders and members of the three expeditions, in which every aspect of the subject has been dealt with in great detail. But this is not all, for these narratives have been admirably summarised and woven into a single story entitled "The Epic of Mount Everest", by Sir Francis Younghusband.

What are the chances of success in 1933? A great deal, in fact almost everything, depends on the weather, and in weather we include wind. The very best laid plans may be wrecked at the last moment by one of those sudden changes which occur in the high Himalaya without warning. Wireless might be used to receive weather reports from the Indian Meteorological Department, but whether they could give indications of the local changes is more than doubtful.

The climbers must be absolutely fit and have had an opportunity of acclimatisation, undisturbed by any incident calling for great exertion on their part, such as having to rescue porters from dangerous positions. Yet such incidents are liable to occur.

The margin between success and failure must always be small—that is what makes it such a great adventure. Many favourable conditions must conspire to take the climbers to the summit; without these, success is doubtful.

We have no information as to the plans of the new expedition but we fancy the same camps will be occupied up to, and including, Camp IV on the Chang La (22,990 ft.) with, perhaps, some form of portable hut at Camp III as has been suggested. Higher up an attempt may probably be made to establish three camps in order to climb the remaining 6,000 ft.

As regards oxygen, since 1924 a much lighter form of apparatus has been constructed, weighing only about 12 lb.* While a high degree of acclimatisation will be aimed at by the climbers selected for the final assault, no doubt the latest form of light oxygen equipment will be provided, so that it can be used if required for the last portions of the ascent. Aptitude for acclimatisation appears to vary with the individual. With some persons, deterioration, due to remaining at high altitudes, may set in before acclimatisation has been fully attained; this has always to be reckoned with. We think, given reasonable luck, Everest will be climbed. If fortune smiles the summit will be reached.

The new expedition will be led by Mr. Hugh Ruttledge, formerly of the Indian Civil Service, who has had a great deal of Himalayan experience. The other members of the expedition are Mr. F. S. Smythe, leader of the successful Kamet expedition, with three of his companions—Capt. Burney, Dr. Raymond Green, and Mr. E. E. Shipton; Mr. Noel Odell, Mr. C. G. Crawford, Mr. Shebbear, members of former Everest expeditions; Messrs. Wyn Harris, J. Longland, G. Wood-Johnson, and Capt. Hugh Boustead, and possibly Dr. W. McLean as second doctor; Mr. L. R. Wager, of the Arctic Air Route Expedition, 1930-31, and Mr. T. Brocklebank.

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* See NATURE, 128, 1037, Dec. 19, 1931.

Scientific Centenaries in 1933

By ENG.-CAPT. EDGAR C. SMITH, O.B.E., R.N.

THE year which has just closed saw the commemoration of the centenaries of many famous men, among whom were Scott, Goethe, Leeuwenhoek, Locke and Warren Hastings. Of especial interest to men of science was the commemoration of the tercentenary of Wren, while the celebration at Cologne of the centenary of Otto attracted considerable attention in the engineering world.

The closing month of the year also saw the commemoration of four other men distinguished as engineers or inventors. On December 7, the American Society of Mechanical Engineers at its annual dinner paid tribute to the memory of John Edson Sweet (1832–1916), a founder of the Society and once professor of engineering at Cornell, and to the memory of Alexander Lyman Holley (1832–1882), a singularly gifted man, whose monument in Washington Square, New York, describes him as "Foremost among those whose genius and energy established in America and improved throughout the world the manufacture of Bessemer steel". Eight days later, on December 15, a ceremony took place at the base of the Eiffel Tower to commemorate the centenary of the birth of its constructor, Gustave Eiffel (1832–1923), while on December 23 various tributes were paid to the memory of Sir Richard Arkwright (1732–1792) who reduced to practice the principle of roller drawing in spinning machines, and was the founder of the factory system of cotton manufacture as we know it to-day. Lecky, the historian, speaking of the wealth which accrued to Great Britain through the cotton mill and the steam engine, and the power this wealth gave the country for carrying on the great French wars, declared that Arkwright and Watt deserved statues beside those of Wellington and Nelson, but so far no monument has ever been erected by his countrymen to Arkwright.

Earlier in the year, at Camborne, Prince George unveiled a statue of the Cornish engineer, Richard Trevithick, the centenary of whose death, falling on April 22 this year, will be commemorated by the engineering world on a scale in keeping with Trevithick's place as a pioneer. Trevithick died at Dartford, Kent, a poor man and for half a century was almost forgotten. The publication of his life by his son in 1872 did much to rescue his achievements from oblivion, and in 1888 a memorial window was erected to him in Westminster Abbey.

The forthcoming celebration is being supported by the leading engineering societies of Great Britain, and the arrangements are in the hands of a committee of which Sir Murdoch Macdonald is chairman. There will be memorial services in Dartford Parish Church and Westminster Abbey, an eminent engineer will deliver an address on Trevithick's work as an inventor, and the committee hopes to be able to erect tablets to Trevithick at his birthplace, Illogan, Cornwall, and also at Pen-y-daren, South Wales, and near Euston Road, London, to record his early attempts to introduce steam locomotion on roads and railways. Trevithick's reputation has never stood higher than it does to-day. He may indeed be proclaimed the father of the high-pressure steam engine.

Many other engineering centenaries also occur this year. A far less well-known inventor who died three months before Trevithick was Frederick König (1774–1833), whose four patents of 1810–14 led to the construction of the flat-bed printing press in which the paper was pressed against the type by a revolving cylinder. A red letter day in the history of printing was November 28, 1814, when the *Times* was first produced on a König machine driven by a steam engine.

Two centuries ago, on February 11, 1733, John Perry died at Spalding at the age of sixty-three years. For many years he was comptroller of maritime works under Peter the Great. He constructed harbour works in Great Britain and as the inscription on his tomb in Spalding Parish Church records, he was "Employed by ye Parliament to stop Dagenham Breach which he Effected and thereby Preserved the Navigation of the River of Thames and Rescued many Private Familys from Ruin".

Engineers born a hundred years ago include Sir Richard Tangye (1833-1906), the best known of the brothers who built up the great Cornwall Works at Birmingham ; Thomas Edwards Vickers (1833–1915), another engineer and captain of industry of world-wide fame ; James Robson (1833–1913), a pioneer of the gas engine ; Henry Wilde (1833–1919), one of the leading inventors of the dynamo and Rudolph Haack (1833–1909) who at Stettin built the first ironclad constructed in Germany, and helped to lay the foundation of the German shipbuilding industry.

Turning to other fields of human endeavour, it is not necessary to stress the interest which is attached to the bicentenary of the birth of Joseph Priestley (1733–1804) who was born at Birstal, Leeds, and died at Northumberland, Pennsylvania. The statues of Priestley at Leeds, Birmingham and Oxford, testify to the esteem in which his memory has been held, and it may be recalled that it was at the celebration on August 1, 1874, of the centenary of his discovery of oxygen, on the piazza of his dwelling-house in Northumberland, that the American Chemical Society was founded, one of many instances of the value of such commemorations. Priestley was one of the few Englishmen elected a foreign associate of the Institute of France, the secretary of which, Cuvier, in his *éloge*, referred to him as "le père de chimie moderne qui ne voulait pas reconnaître sa fille".

Among Priestley's intimate friends was the geologist and chemist, Richard Kirwan (1733–1812), who, like Priestley, received the Copley medal of the Royal Society. Kirwan was in correspondence with many of the leading savants of Europe, his London house was the meeting-place of the learned and after he returned to his native country, he became president of the Royal Irish Academy.

The year 1733 also saw the birth of Jean Charles Borda (1733–1799), the eminent French mathematician and astronomer ; of Dr. Thomas Hornsby (1733–1810), the successor of Bradley as Savilian professor of astronomy at Oxford and the first Radcliffe Observer, and of the famous German traveller, Carsten Niebuhr (1733–1815), the pupil and friend of the astronomer, Tobias Mayer.

Somewhat later than these eighteenth century worthies came Joseph Nicephore Niepce (1765–1833), the French chemist, whose statue at Chalons recalls his achievement of obtaining sun prints on metal plates ; Thomas Allan (1777–1833), the Edinburgh mineralogist ; Adrien Marie Legendre (1752–1833), the French mathematician, writer of many works and the contemporary of Lagrange and Laplace. Legendre's "Elements of Geometry" was translated into English by Thomas Carlyle.

To the names of these three men who died in 1833 may be added that of Dr. William Babington (1756–1833), whose statue in St. Paul's Cathedral is regarded as a fine example of portraiture in marble. Babington was physician for many years to Guy's Hospital, and it was at his house that the meetings took place which led to the foundation of the Geological Society. Active to the last, when seventy-six years of age, he presided over the Priestley centenary festival on March 26, 1833, but died of influenza three days later. He is buried in St. Mary Aldermanbury in the City.

Coming nearer our own times, it is but natural that with increase of opportunity, the lists of men who make notable contributions to discovery and progress should grow longer. "Life," said Emerson, "is girt round with a zodiac of sciences, the contributions of men who have perished to add their point of light to our sky. These road makers on every hand enrich us." To this ever-increasing group of men belong many born in 1833, among them Sir Henry Roscoe (1833–1915) ; the German mathematician, Rudolph Clebsch (1833–1872) ; and the meteorologist, Robert Henry Scott (1833–1916), the successor of FitzRoy at the Meteorological Office. On April 15 was born Maurice Loewy (1833–1907), the constructor of the equatorial coudé and the successor of Tisserand as director of the Paris Observatory ; on May 5, Ferdinand, Baron von Richthofen (1833–1905), the geologist and geographer ; on March 16, Hilary Bauerman (1833–1909), the metallurgist and benefactor of the Iron and Steel Institute and the Royal School of Mines ; and on June 29, Peter Waage (1833–1900), the distinguished Norwegian chemist, student of Bunsen, successor of Strecker and collaborator with Guldberg.

Then, too, on October 15 and October 21, 1833, respectively, occurred the births of Frederick Guthrie (1833–1886), through whose efforts the Physical Society of London was founded, and of Alfred Bernhard Nobel (1833–1896), the Swedish engineer, chemist and inventor of explosives, by whose will of November 27, 1895, the bulk of his great fortune was used for founding the famous Nobel prizes for physics, chemistry, medicine, literature and peace.

Empire Broadcasting

IN the field of radio communication, the last few weeks of the year 1932 were conspicuous for the inauguration of a regular broadcasting service between Great Britain and the various portions of the British Empire. The developments which took place in this connexion during 1932 are somewhat striking, and they are recorded in some detail in the B.B.C. Year Book for 1933. From the previous edition of this Year Book, it appeared that little progress was likely in connexion with the Empire broadcasting scheme drawn up by the British Broadcasting Corporation owing to lack of support by the Colonial and Imperial Conferences of 1930, and the responsible authorities in the overseas countries concerned. In November 1931, however, the B.B.C. announced its intention of developing the Empire broadcasting scheme on its own initiative, and the rapid progress made during the ensuing twelve months is illustrated by the fact that the regular service from the new station erected at Daventry for the purpose began on December 19.

As an aid in the development of this new broadcasting service, the B.B.C. had the benefit of about five years' experience with an experimental short wave station erected at the Marconi Company's works at Chelmsford. Owing to the fact that the distances from Great Britain to the various Dominions and Colonies are in the range 2,000–13,000 miles, it is necessary to make use of the short wave-length band of approximately 12–60 metres for radio communication. The Chelmsford station operated on a wave-length of 25 metres, and enabled a large amount of technical data to be obtained in connexion with short wave broadcasting. A little consideration of the matter will show, however, that one transmitting station working on a single wave-length cannot provide a satisfactory Empire broadcasting service. In the first place, account must be taken of the wide differences in local time in the various countries concerned, and it is obvious that the broadcast reception must be possible in general during the leisure hours of the inhabitants of those countries. Secondly, as a result of experience, not only in broadcasting but also with ordinary telephonic and telegraphic radio communication on short waves, it is known that the choice of the best wave-length varies with the distance to be covered, and whether the portion of the earth over which the communication takes place is in sunlight or darkness. Following on the latter condition, it is frequently found that diurnal and seasonal variations in the ionosphere, without which long-distance short wave communication would apparently not be possible, make it necessary to have a choice of at least two wave-lengths in order to maintain regular communication between two fixed points. Lastly, a directive antenna system at either or both ends of the communication link, makes such a vast improvement in general efficiency that the arrangement is always employed where possible in commercial short wave communication.

Based upon the considerations outlined above, the British Empire has been divided up into five zones and the new station at Daventry is designed to supply a direct broadcasting service to listeners in each zone, a two-hour programme being given daily between 6 P.M. and midnight local time, with the hours 8–10 P.M. as a focus wherever possible. For each zone a separate antenna array has been erected at Daventry, each array being so oriented as to give a not too highly concentrated beam of radiation in the desired direction. In the case of the first array, for Australasia, the transmission is limited to a single wave-length of 25·5 metres, but the radiator and reflector units of the array are reversible so that the waves can be transmitted around the earth in either direction. In the case of the other four zones, two or three wave-lengths are available as required. The approximate constitution of these zones, with the wave-lengths available, and the periods in G.M.T. at which the transmissions take place in Great Britain are given in the following table:

Zone.	Countries.	Wave-lengths (metres).	Approximate programme period (G.M.T.).
1	Australasia, including New Zealand, Borneo, New Guinea and the Pacific Islands	25·5	9.30–11.30 A.M.
2	India, with Burma and the Federated Malay States..	17, 25 and 32	2.30– 4.30 P.M.
3	South Africa, with East Africa, Palestine, Sudan and Somaliland	14 and 32	6.0 – 8.0 P.M.
4	West Africa, Nigeria and Gold Coast, with Tristan da Cunha and Falkland Islands	32 and 48	8.0 –10.0 P.M.
5	Canada, Newfoundland and West Indies	19, 32 and 48	1.0 – 3.0 A.M.

In addition to the directional antenna arrays, six omnidirectional aerials have been provided and these will be used for transmitting any special programmes which it may be desired to receive at any hour in any part of the world.

These arrays and aerials are supplied by feeders or transmission lines from two transmitters housed in the new station building at Daventry. Each of these transmitters is of modern design and construction, and comprises a crystal-controlled master oscillator followed by the necessary frequency multiplying, modulating and energy amplifying stages: these terminate in a final amplifier which consists of four 15 kw. valves connected in push-pull arrangement, the output circuits of which are coupled to the aerial feeder.

The programme supplied through this station will comprise items largely of an original or topical nature, having entertainment or news interest of a type not normally obtainable in the countries where reception takes place. Owing to the difficulties of arranging repeat performances, particularly at the more inconvenient times shown in the above table, the B.B.C. will make extensive use of modern electrical methods of programme recording for use in the transmitters. As an example of the use of the station, reference may be made to the occasion of the broadcasting of the King's Christmas message on December 25 last, when the vision of Sir Ambrose Fleming and other pioneers of radio communication, of a single human voice addressing listeners over the whole surface of the earth, was realised. In addition to being transmitted by all the B.B.C. stations serving Great Britain, it was sent through the two Empire transmitters at Daventry. One of these was connected to the Indian zone array, for which zone the transmission took place at the normal time. The other short wave transmitter was operated on a wave-length of about 20 metres, and supplied an omnidirectional aerial, so as to broadcast so far as possible in all directions. In addition, the programme was recorded by Blattnerphone and used for re-transmission in the various zone programmes later in the day.

In addition to the direct reception from Daventry on listeners' private receiving sets, it is likely that the broadcasting authorities in the Dominions will arrange for the relaying of some programmes through their local stations operating on medium wave-lengths. From the point of view of the B.B.C., the whole Empire service will be experimental for a period of about six months, during which arrangements will be made to collect reports of reception from selected listeners in all parts of the Empire.

R. L. S.-R.

News and Views

New Year Honours

THE New Year Honours List includes the following names of scientific workers and others associated with scientific work: *Baron:* Sir Thomas Horder, Bt., senior physician to St. Bartholomew's Hospital. *Knight of the Thistle:* The Right Honourable Sir Herbert Maxwell, Bt., chairman of the Royal Commission on Scottish Historical Monuments, president of the Society of Antiquaries of Scotland, 1900–13. *K.C.B.:* Sir Frederick Leith-Ross, chief economic adviser to His Majesty's Government. *K.C.I.E.:* Major-General J. W. D. Megaw, Director-General of the Indian Medical Service. *K.C.V.O.:* Mr. F. J. Willans, surgeon apothecary to H.M. Household at Sandringham. *Knights:* Mr. C. A. Cochrane, chairman of the Council of Armstrong College, University of Durham. Mr. H. H. Dalrymple-Hay, consulting engineer, for his inventions and services in connexion with the construction of tube railways. Prof. F. T. G. Hobday, Principal and Dean of the Royal Veterinary College. Mr. A. J. C. Huddleston, lately economic adviser to the Sudan Government. Mr. J. L. McKelvey, for services to surgery in the Commonwealth of Australia. Mr. E. R. D. Maclagan, Director and Secretary, Victoria and Albert Museum. Mr. W. Perry, president of the Royal Agricultural Society, New Zealand. Mr. R. S. Rait, Principal and Vice-Chancellor of the University of Glasgow since 1929. *C.H.:* Rev. John Scott Lidgett, president of the Methodist Church, Vice-Chancellor of the University of London in 1930–31 and 1931–32. *C.M.G.:* Dr. J. J. C. Bradfield, Government engineer, Sydney Harbour Bridge, State of New South Wales. Prof. D. B. Copland, professor of commerce, University of Melbourne. Mr. L. Ennis, constructing engineer for Messrs. Dorman, Long and Co., Sydney Harbour Bridge, New South Wales. Mr. W. B. Johnson, director of Medical and Sanitary Service, Nigeria. Mr. W. J. U. Woolcock, formerly general manager of the Association of British Chemical Manufacturers, chairman of the Committee of Non-official Advisers associated with the industrial advisers of the United Kingdom delegation at the Ottawa Conference. *C.I.E.:* Major-Gen. W. C. H. Forster, Surgeon-General with the Government of Bombay. Lieut.-Col. R. B. Seymour Sewell, director of the Zoological Survey of India. Mr. C. G. Trevor, chief conservator of forests, Punjab and North-West Frontier Province. Col. J. N. Walker, director of the Medical Department and Sanitary Commissioner, his Exalted Highness the Nizam's Government, Hyderabad, Deccan. *C.B.E.:* Mrs. Alice Baker, one of the founders of the Thomas Baker, Alice Baker, and Eleanor Shaw Medical Research Institute, Melbourne, Commonwealth of Australia. Dr. F. H. A. Marshall, reader in agricultural physiology in the University of Cambridge. Dr. S. W. Smith, chief assayer, Royal Mint, and president of the Institute of Mining and Metallurgy. Dr. H. A. Tempany, director of agriculture, Straits Settlements and Federated Malay States. Prof. H. E. Whitfeld, Vice-Chancellor of the University, State of Western Australia. *O.B.E.:* Dr. J. T. Bradley, chief medical officer, Seychelles. Mr. A. V. Elsden, War Department chemist, Royal Arsenal, Woolwich. Mr. A. McCallum, senior inspector for agricultural education, Department of Agriculture for Scotland. Mitharam Pribhdas Mathrani, executive engineer, Left Works Division, Lloyd Barrage Circle, Sukkur, Bombay. Dr. S. A. Neave, assistant director, Imperial Institute of Entomology. Mr. J. Smith, director of animal health and acting secretary for agriculture, Northern Rhodesia. Mr. H. W. O. Taylor, executive engineer, Right Works Division, Lloyd Barrage Circle, Sukkur, Bombay. Mr. R. S. Taylor, principal medical officer, Somaliland Protectorate. *M.B.E.:* Mr. J. Coelho, assistant Crown surveyor and assistant engineer, Public Works Department, Gibraltar. Mr. W. M. Schutte, agricultural engineer to the Government of Bombay. Mr. H. N. Williams, assistant engineer, Irrigation Department, Iraq.

Calendar of Nature Topics

FOR the past nine years calendars have been published in our columns recording week by week notes of historic interest relating to people and institutions, discoveries and inventions, customs, festivals, geographical exploration and other matters appropriate to a scientific "Book of Days". We began in 1924 with "Early Science at the Royal Society", and during last year appeared a "Calendar of Geographical Exploration", which was contributed by Miss R. M. Fleming and most admirably fulfilled its purpose. With this issue begins an annual cycle of a different kind relating to natural history in a wide sense, as was understood, for example, by Gilbert White in the notes and letters which make up his famous "Natural History of Selborne". Prof. James Ritchie, Regius professor of natural history in the University of Aberdeen, will be chiefly responsible for the weekly notes in this "Calendar of Nature Topics", and Dr. C. E. P. Brooks will deal with meteorological events of topical interest. In addition, we hope to receive occasional notes on such subjects as agriculture, botany, marine biology, fisheries and similar branches of pure and applied natural history from other contributors.

It is not intended that this year's Calendar shall be of the usual type, recording aspects of Nature or country life week by week in Great Britain, but that it shall take a much wider outlook. The main idea will be to bring together, in chronological sequence throughout the year, observations and conclusions representing ascertained knowledge to-day on the subjects of the notes; and the range of the natural occurrences or phenomena may be that of the whole world. It is unlikely, therefore, that there will be any lack of suitable material; nevertheless, suggestions of topics of interest for inclusion in this new Calendar, or short notes which might be used, would be helpful and should be sent to Prof. Ritchie at the University of Aberdeen. It need scarcely be said that any such communications should be sent well in advance of the dates to which they refer.

Centenary of Legendre, 1752-1833

The centenary occurs on January 10 of the death of the eminent French mathematician, Adrien Marie Legendre, whose labours over a period of sixty years were contemporary with those of Lagrange and Laplace, with whom he formed part of "that constellation of mathematical talent of which Paris was for more than two generations the main centre". Legendre was eighty years of age when he died, having been born at Toulouse on September 18, 1752. He was educated at the Collège Mazarin and at the age of twenty-five became a professor at the military school in Paris. He published his first important memoir, on attractions, in 1783, and in that year he was elected a member of the Paris Academy of Sciences. Four years later, with Cassini and Mechain, he was appointed to conduct the geodetical operations for connecting the Observatories of Paris and Greenwich. Through this he visited London, and was made a foreign member of the Royal Society. Unlike many of his contemporaries, he passed through the Revolution unscathed and by his writings and his work on commissions continued to add to his reputation. In 1795 he became a member of the staff of the famous Ecole Normale. His chief works were his "Géométrie" (1794), which was translated into English by Thomas Carlyle, his "Théorie des Nombres" (1798), "Calcul Intégral" (1811-1826) and "Fonctions Elliptiques" (1825-26). A few weeks before his death he added to the last of these another volume, which contained some of the researches of the younger mathematicians, Abel and Jacobi, the value of whose work Legendre quickly recognised. Among the best-known pupils of Legendre were Cauchy and Arago. The death of Legendre took place at his house at Auteuil.

Sir Henry Roscoe, 1833-1915

Among those whose efforts aroused Great Britain to a realisation of the value of scientific education few did more than Sir Henry Enfield Roscoe, whose birth took place in London on January 7, 1833, a century ago. The son of a judge and a grandson of William Roscoe the historian, he got his second christian name from a great-grandfather, Dr. Enfield, a colleague of Priestley's at Warrington. He was sent first to Liverpool High School and afterwards to University College, London, where he came under the influence of Graham and Williamson. Later, he spent some time under Bunsen, working in the historic old laboratory at Heidelberg where "beneath the stone floor at our feet slept the dead monks, and on their tombstones we threw our waste precipitates". Returning from Germany, Roscoe at the age of twenty-four years was appointed to succeed Frankland at Owens College, Manchester, a position he held with conspicuous success for thirty years. He was one of the foremost in engendering a spirit of research and many of his students afterwards rose to high rank. His collaboration with Dittmar, Harden and Schorlemmer, the first professor of organic chemistry in Great Britain, led to the publication of many notable works some of which are still sought after. One of his achievements as an experimentalist was the isolation for the first time of vanadium. He was elected a fellow of the Royal Society in 1863 and awarded a Royal medal in 1874; he served as president of the Society of Chemical Industry in 1881, and as president of the Chemical Society in 1882. He was elected member of parliament for South Manchester in 1885; in 1887, the year in which he retired from Owens College, he was president of the British Association. He was a member of various Royal commissions, and from 1896 until 1902 was Vice-Chancellor of the University of London. His eightieth birthday was marked by the presentation of his bust to the Chemical Society. He died on December 18, 1915, at Woodcote Lodge, West Horsley, Surrey, and was buried four days later in Brookwood Cemetery.

North Atlantic Gale

The last day of the old year and the first few days of the new have proved remarkably tempestuous on the North Atlantic. During the near approach to Ireland on December 31 of an exceptionally intense cyclonic depression, a destructive gale occurred in Ireland. At Valentia Observatory the pressure tube anemograph registered a gust of 96 miles an hour, which is the highest gust recorded there for at least sixteen years. Barometric readings in Iceland were unusually low during the three first days of 1933. On January 3, pressure at sea-level was less than 928 millibars (27·4 in.) near the centre of a depression lying off the south-west coast of Iceland, but it is not possible to say by how much it fell below that value. That depression was certainly among the deepest of which we have any record since daily synoptic weather charts of the North Atlantic were first begun. On those prepared and published by the Danish and German Admiralties, there is only one depression which looks to have had such a low reading, that of February 24, 1903, which had been preceded five days earlier by another only slightly less intense.

Earthquake in South-East Africa

THE strong earthquake that occurred shortly after 8.30 A.M. on December 31 in south-east Africa possesses some interest as it visited a region in which destructive shocks are almost or quite unknown. Its epicentre seems to have been in Zululand, for damage to buildings was caused at Eshowe and other places. The shock was felt all over Zululand and Natal, in various parts of the Transvaal and the Free State, and from Lorenzo Marquez on the north to the Transkei on the south. Its disturbed area must therefore have contained about a quarter of a million square miles, which is more than that shaken by the great Japanese earthquake of 1923.

Ancient Man in Palestine

IT is reported that Miss Dorothy Garrod, director of the Joint Expedition of the School of Archæology in Palestine and the American School of Prehistoric Research, has discovered further remains of Palestine man. A massive and powerful lower jaw has been found in the cave of the Oven at the foot of Mount Carmel. In an announcement of the discovery by Dr. Grant MacCurdy, of Yale University, director of the American School of Prehistoric Research, it is stated that the character of the newly discovered jaw fully conforms to the view, based upon the evidence previously discovered in the caves of Mount Carmel, that Palestine man, while presenting Neanderthaloid characters, is of a distinct type. It is also announced that a cap or veil made of dentalia shells has been discovered in an adjacent cave. It will be remembered that in the course of the excavations of 1931, Miss Garrod found a cap of dentalia shells still attached to a skull from a mesolithic series in one of the Mugharet el-Wad caves.

Cave Paintings in the Pyrenees

FURTHER details of an interesting discovery of the prehistoric painting of a horse in a cave in the Pyrenees, briefly announced some weeks ago, are now supplied by Science Service, Washington D.C. The cave, to be known as La Grotte de la Bastide, is situated near the village of La Bastide, Hautes Pyrénées, and was discovered by M. Norbert Casterat, pupil of Count Bégouen. At the entrance of the cave were intact Magdalenian hearths, and on the walls were a number of engravings and polychrome paintings, including human figures, and as the central object, a polychrome painting of a horse. The horse is described as 'superb' and is an artistic production comparable with the famous horse of the Altamira cave at Santander. The figure is more than six feet long, and is executed in red with black muzzle. The mane is erect; the eye, ear and nostril being delicately engraved. High lights are indicated on shoulders, stomach and flanks. Judging from this description, the painting would appear in every way to be an exceptionally fine example of cave art.

Lightning Investigation

MR. W. H. F. TREDRE, honorary technical secretary of the Educational Section of the South African Institute of Electrical Engineers, Kelvin House, 100 Fox Street, Johannesburg, has favoured us with some interesting particulars relating to the organisation which has been established for the study of lightning in South Africa. The movement was initiated by Mr. T. P. Pask in a paper read before the South African Institute of Electrical Engineers in April 1930; as a result a committee was formed under the chairmanship of Mr. Pask. The present organisation consists of a main committee and three subsidiary committees dealing with each of the subjects research, statistics and education. With regard to the research, the chairman is Dr. B. F. J. Schonland, of Capetown—the scope of the work it is proposed to undertake includes the collection of photographs of lightning strokes and their effects taken by means of revolving lenses of the type suggested by Prof. Boys, of klydonograms and cathode ray oscillograms of lightning waves, point discharge work, etc. The activities of the statistical section may be illustrated by the fact that there are 3,500 observers throughout the Union who are collaborating by making notes on the history of storms. These observers are working under the supervision of Mr. G. W. Cox, acting chief meteorologist of the Union. The educational section will disseminate information on protective measures through the medium of the Press, schools, pamphlets, etc. During the 1933 session it has been arranged for certain of the investigators to read papers on the subjects of their work before the South African Institute of Electrical Engineers. It is anticipated that interesting results will be obtained at the end of the present lightning season.

Electrification of Railways in Britain

IN a paper by F. Lydall to the Institute of Transport read on December 12, the electrification of railways is considered under two headings, 'suburban passenger' and the 'general' electrification usually referred to as main line electrification. The main characteristics of the former type of traction are rapid acceleration and increased terminal capacity due to the elimination of locomotives and the ability of the trains to run equally well in either direction. The practically universal adoption of the multiple unit system for suburban traffic, where several coaches throughout the train are provided with motors, proves that the flexibility this gives to the make-up of the train is of great value in practice. It is usual to divide the trains into units, each unit consisting of one motor coach and several trailer coaches. In the new express service from London to Brighton, the trains are made up of six or twelve coaches, two or four of which are motor coaches, each being equipped with four 225 horse power motors. Over a new portion of an American railway where the stops are 1·55 miles apart, the average speed including stops is 31 miles per hour; on another portion of the line where the stops are 2·9 miles apart the average speed is 40 miles per hour. The increase over the speed of steam trains in Great Britain is about 50 per cent. This speed could be easily increased; it is merely a question of cost. Mr. Lydall considers that on main lines it would be found advisable to work not less than one third of the passenger train mileage by multiple unit stock. By electrification the average speed of passenger trains in Britain could be raised by 25 per cent. The combination of greater comfort, higher speed, and more frequent service would attract many more passengers, and the latter two would also enable the railways to recover much of their goods traffic which at present goes by road transport.

Motor Car Lights on the Road

WHEN motor cars pass each other at night time, there is often a blinding glare in the drivers' eyes. We learn from *Science Service* that, in the United States, the Bureau of Standards has been conducting an extended research on head-lights to discover how glare can be avoided. Dr. Dickinson of the Bureau of Standards concludes that the most important difficulty in obtaining safe head-lighting is the great disparity in brightness between beams from different lamps. One head-light beam is frequently ten times as intense as another. The driver with the dim lights experiences an almost complete lack of visibility when his car plunges into the bright light of the approaching car. Dr. Dickinson suggests that if the lights were kept so that no head-lamp was more than two or three times brighter than another, most of the glare problem would be solved. Most drivers rely on what they can see of the curb rather than what they see of the oncoming car. Hence the light is increased for a hundred feet in front of the car and the beam is widespread horizontally and slightly depressed. Few motorists realise that it is more dangerous to pass a car that is standing still than one that is running fairly fast. A driver in judging whether the road is clear relies on what he has seen during the past few seconds by the light of the oncoming car. But the road immediately at the back of a car at rest is not illuminated in this way and so danger may lurk there unseen. Exposed lights along the roads sometimes increase the risks of night driving. They often make objects almost invisible which could easily be seen by the head-lights alone.

Early Days of the Turbine

IN his inaugural address as chairman of the North-Eastern Centre of the Institution of Electrical Engineers, Mr. C. Turnbull gave interesting reminiscences of some of the initial difficulties Sir Charles Parsons met in perfecting the steam turbine. His experiments with early forms of the turbine were in entirely new and unexplored regions of engineering. Everything had to be found out. Steel discs were run under stresses that no one could calculate and no one knew whether they were safe or not. The early high-speed turbines ran at 4,800 revolutions a minute. But thanks to the wonderful care always taken at Parsons's works, accidents were very rare. When driving dynamos at high speeds, the armature reaction caused great difficulty. Several solutions were adopted for turbo-alternators. In one way the brushes were moved automatically with the load by steam pressure and the variation of the strength of the field was counteracted by special windings. A further difficulty was that owing to the springing of the shaft, the connexions between the armature and the commutator used to give trouble. This was overcome by the use of flexible connectors, a device first proposed by Parsons. It has proved of the greatest value. Details are given of the famous *Turbinia* and the heartbreaking experiences with the destroyers *Viper* and *Cobra*. Mr. Turnbull tells how Parsons refused to give up and how his perseverance ultimately led to success. Another great invention that came from Parsons's works was the invention of means for balancing high-speed machinery. The early days of the steam turbine were hard days and the labour expended seemed to lead to nothing. At one time it was doubtful if the steam turbine would ever become practical. The story of Parsons's life should prove very encouraging to young and old inventors.

The New Helm or Steering Orders

THROUGH the work of the International Safety at Sea and Load Line Convention, and the passing of the Merchant Shipping Act, 1932, and in accordance with the subsequent instructions of the Board of Trade, on January 1 the 'direct' system of helm orders came into use on all British vessels. For centuries the order to "Starboard the helm" or "Port the helm" has caused the ship's head to go in the opposite direction, the practice having come down through the centuries when tillers were in use. Under the new regulations the order "Starboard" will be given, when it is intended that the wheel, the rudder blade and the head of the ship should go to starboard, and the order "Port" will be given when it is intended that the wheel, the rudder blade and the ship's head should go to port. Though it is expected that little difficulty will be experienced in changing over from the 'indirect' system to the 'direct' system, for a time the orders will be given in the words "Wheel to Starboard" and "Wheel to Port", thus enabling the helmsman to adapt himself gradually to the new system. Like most innovations of the kind, the change in established practice has not been introduced without considerable criticism and opposition, but it is probable that in a very short time it will be regarded as an eminently sensible and desirable alteration.

Research at the Port Erin Biological Station

A SEPARATE report on the work of the Port Erin Biological Station has been discontinued and a survey of the research done is now published in the "Report for 1931 (No. 40) on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Annual Report of the Marine Biological Station (No. 45) at Port Erin, Isle of Man", 1932, edited by the late Prof. James Johnstone and Dr. R. J. Daniel. In this report a large amount of original work is also published. This covers a wide field and deals with the abdominal musculature of Crustacea, herring investigations, hydrography and the fauna and flora of the Isle of Man. The Port Erin Station has recently (1931–32) had a new laboratory added, fully equipped for practical teaching and with about thirty work places. New engines and pumps have been installed. The plaice hatchery and lobster culture are still continued. Besides liberating lobsterlings hatched and reared in the laboratory, a number were placed singly in glass rearing jars and fed on crab, boiled and ground to a fine meal. Nearly half of the number survived and cast their shells four or five times, making eight or nine casts between the period of hatching and the end of the first year. The newly hatched young are fed on fresh plankton; after the fourth moult (lobsterling) they are fed on crushed crab, small pieces of fish being added after the fifth month. These interesting experiments are to be continued on a larger scale next year. Dr. R. J. Daniel has completed his comparative work on the abdominal muscles of the Malacostraca and has drawn up an elaborate phylogenetic table to express the relationships that exist between the main ventral system of musculature.

A New Source of Rubber

IN order to avoid the necessity of importing rubber from tropical countries, the Soviet Government has organised investigations of native plants likely to contain this valuable product in their latex. Amongst various plants studied, several species of *Chondrilla* (Compositæ) occurring mainly in the southern sandy regions, proved to be very promising and their cultivation is being carried out on an extensive scale. Green parts of the plant are cut and rubber prepared from the latex. The quantities obtained must be rather small, since only up to 2 per cent of the green mass represents rubber. Recently, however, it was found that certain insects feeding on roots of *Chondrilla* can be utilised for extracting rubber from the latex (Veltischev and Luppova, *Priroda*, No. 10, 1932). One of these is a caterpillar of a pyralid moth, *Bradyrrhoa gilveolella* Tr., which feeds on the roots and constructs round its body a tube formed of condensed latex and sand grains. Up to thirty and more such tubes can be found on the roots of a single plant, and the tubes contain 9–17 per cent of rubber. Another useful insect is the larva of a buprestid beetle, *Sphenoptera foveola* Gebl., which also feeds on roots of *Chondrilla* and causes a large outflow of latex solidifying round the root. These swellings contain up to 4 per cent of rubber. Neither insect produces any serious effect on the infested plant, and healthy plants can be infested artificially in order to increase their productivity. Experiments are being made to test the practical and economic side of this method of obtaining rubber.

Cultivation of Green Crops

BULLETIN No. 53 of the Ministry of Agriculture and Fisheries ("Cabbages and Related Green Crops". London: H.M. Stationery Office, Price 9d.) has recently been published. It traces the botanical origin of the various green crops, and deals in detail with the soils, rotation, manuring, harvesting and marketing most suitable for cabbages, savoys, Brussels sprouts, cauliflowers and several miscellaneous green crops. A very interesting section deals with the saving of seed in the counties the climate of which is most suitable for this purpose. Pests and diseases are not mentioned in the present pamphlet, since they have been described very fully in other publications of the Ministry.

Astrolabes and Their History

ASTROLABES are not as generally available for study in the museums of the world as their scientific importance and artistic qualities would merit, but all who may desire to become better acquainted with this instrument in its various forms are now given the opportunity. Subscribers are invited for a comprehensive work, entitled "The Astrolabes of the World", based upon the series of instruments in the Lewis Evans Collection in the Old Ashmolean Museum at Oxford, in the Science Museum at South Kensington, and in several other public and private collections in Europe and America. The early Greek treatise on the astrolabe, by Philopon, and the Syriac treatise by Sabokt—both dating from the seventh century—will appear in English for the first time. Illustrations are given of Chaucer's astrolabe, now clearly identified by the character of the rete as depicted in MSS. and many instruments contemporary with Columbus and Drake, are figured. The subject is of fundamental importance to all students of the history of astronomy, geography and surveying, and indeed to the history of science generally, for it may truly be said that the astrolabe kept alight the torch of the scientific method of observation and of computation of results, in many countries, and through many dark ages, when larger instruments and well equipped observatories did not exist. It is hoped that the principal reference libraries may obtain copies of this monumental work, which it is proposed to issue in two quarto volumes, containing more than 600 pages and 155 plates, of which 12 are in collotype, and 216 text figures. The price to subscribers is ten guineas. Subscription forms may be obtained from Dr. R. T. Gunther, Curator of the Lewis Evans Collection, in the Old Ashmolean, Broad Street, Oxford.

World Power Conference

The preparatory work of the organising committee at Stockholm of the next World Power Conference, which will take place in 1933 in Scandinavia, is proceeding steadily. The first plenary World Power Conference was held in London in 1924, the next in Berlin in 1930. There have also been sectional meetings with special programmes, for example, at Basel in 1926 and London in 1928. The Scandinavian Conference will be such a special meeting, dealing with the energy problems of large industry and transport. Participation and collaboration of fifteen countries outside Scandinavia is assured and more than 170 reports are announced. Some forty reports to be published at the meeting deal with problems of energy supply in large-scale industry, such as combined power and heat supply, the rôle of large-scale industry in national power schemes, etc. Many of the technical papers deal with the problems of long distance gas transmission, while other papers are devoted to more special power problems concerning the iron and steel industry, pulp and paper, and cement, sugar, textile and other steam heat consuming industries. Energy questions of transport provide the subjects for 62 reports; railway and marine transport, the peculiarities of city and suburban traffic are to be discussed with due emphasis on the new aspects which have been introduced by electric traction and Diesel engines.

Medical Research in South Africa

The annual report of the South African Institute for Medical Research, by the director, Sir Spencer Lister, summarises the work of the Institute during 1931. Methods of dust estimation and studies on underground humidity in the air of the Witwatersrand mines have been pursued. The pneumonia attacking the native labourers in the copper mines of Northern Rhodesia has been investigated, and has been found to be caused by the *Streptococcus pyogenes* and other organisms, but rarely by the pneumococcus. This change of type of the organisms causing pneumonia has also been found in the Kimberley diamond mines. Much experimental work has been done on cancer, and Dr. des Ligneris has found that a micro-organism, *Salmonella gallinarum* of fowl typhoid, if cultivated in the tumour filtrate of the Rous fowl sarcoma for several generations, appears to have the power on inoculation of prolonging the life of fowls with the Rous sarcoma by about fifteen per cent.

The March of Influenza

According to a report of Science Service, Washington, D.C., a considerable outbreak of influenza is in progress in several States of the Union, particularly in the south and west, the United States Public Health Service reporting 14,291 cases during the week ended December 3. In Great Britain outbreaks are reported in Southampton and Birmingham, and during the week ended December 17 in 117 great towns, including London, of England and Wales, 85 deaths from influenza were certified. In the same week Glasgow reported 28 deaths from this disease.

Announcements

The following have been elected officers of the Royal Society of South Africa for 1933: *President:* Dr. W. A. Rogers; *Treasurer:* Dr. L. Crawford; *General Secretary:* Dr. B. F. J. Schonland.

The Royal Society Mond Laboratory at Cambridge will be opened by the Chancellor of the University, the Right Hon. Stanley Baldwin, on February 3. It will be recalled that the hydrogen liquefaction plant of the Laboratory was described in Nature for February 13, 1932, p. 224.

We regret to learn of the death on December 25 of Prof. Paolo Enriques, professor of zoology in the University of Padua and president of the last International Congress of Zoology; he was just starting for Naples to pursue his researches in the Zoological Station. Also of Prof. James Johnstone, professor of oceanography in the University of Liverpool, formerly director of the Marine Biological Station, Port Erin, aged sixty-three years.

Catalogue No. 552 of Messrs. Francis Edwards Ltd., High Street, Marylebone, W.1, includes a miscellaneous collection of books, autographs and manuscripts, falling under such headings as Africa, America, Economics, Geography, History, First Editions, Scripture, Shakespeare and the like. There are also special series such as the publications of the Hakluyt Society and books from special presses such as the Kelmscott and Doves Presses. Among the books listed under Africa to be noted especially are Angas "The Kaffirs" with the coloured lithograph plates (£21) and a copy of the 1727 folio edition in Dutch of Peter Kolben's famous and invaluable account of the Cape of Good Hope (£15). The most notable item offered, however, is George Lily's map of Britain, 1546, of which the only other known, and slightly inferior, copy is in the British Museum, and was one of the six treasures selected from the British Museum for the International Geographical Congress in 1928. Apart from Ptolemy's atlas, this is the first printed map of Great Britain (£105).

Applications are invited for the following appointments, on or before the dates mentioned:—A secretary of the Iron and Steel Institute and editor of the *Proceedings*—The Chairman, Appointments Committee, Iron and Steel Institute, 28, Victoria Street, S.W.1 (Jan. 21). A full-time tutor for the practical course in social science at the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, 73, Strand, W.C.2 (Jan. 31). A professor of textile industries at the University of Leeds—The Registrar (Feb. 28). A principal of the School of Metalliferous Mining (Cornwall)—The Secretary to the Governors, Camborne (March 31).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Disintegration of Light Elements by Fast Protons

SINCE the publication of our paper[1] on the disintegration of elements by fast protons, we have examined some of the light elements more carefully, using much thinner mica windows than we had previously employed on the high voltage tube. With the present arrangement, we can count particles which have passed through only 6 mm. air equivalent of absorber on their way from the target to the ionisation chamber.

In the case of lithium, we have found, in addition to the α-particle group of 8·4 cm. range, another group of particles of much shorter range. The number of these is about equal to that of the long range particles and their maximum range is about 2 cm. The ionisation produced by them indicates that they are α-particles. It will be of interest to examine whether any γ-rays are emitted corresponding to the difference of the energies of the α-particles in the two groups, but on account of the smallness of the effect to be expected, a sensitive method will be necessary.

In the case of boron, the number of particles observed increases rapidly as the total absorption between the target and the ionisation chamber is reduced. The maximum range of these particles is about 3 cm. and in our earlier experiments we determined the number of particles only after passing through the equivalent of 2·9 cm. of air, so that we were very nearly at the end of the range. Decreasing the absorber to 6 mm. of air gives an enormous increase in the number of particles. In this way about twenty-five times as many particles have been obtained from boron as from lithium under the same conditions. We estimate that there is roughly one particle emitted per two million incident protons at 500 kilovolts. The ionisation produced by the particles suggests that they are α-particles, and the energy of the main group would support the assumption that a proton enters the B^{11} nucleus and the resulting nucleus breaks up into three α-particles. There also seem to be present a small number of particles with ranges up to about 5 cm.

J. D. COCKCROFT.
E. T. S. WALTON.

Cavendish Laboratory,
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Dec. 22.

[1] *Proc. Roy. Soc.*, A, 137, 229; 1932.

The Neutron and Neuton, the New Element of Atomic Number Zero

SINCE neutrons were first recognised by Chadwick in the rays from the beryllium nucleus, it may be of interest to note that in 1915 the hydrogen-helium theory[1] considered this nucleus to consist of two doubly charged helium nuclei and a condensed or nuclear hydrogen atom, now called a neutron. In a paper written early in 1919, the formula of the beryllium nucleus was given as $\alpha_2(\eta\beta)$ which in more recent symbols is $\alpha_2(pe)$, where the parentheses were used to emphasise the idea that the proton p and the electron e are united to form a neutral group or neutron.

The suggestion that neutrons exist as separate atoms was made independently at practically the same time by Lord Rutherford (June 3, 1920) and myself (April 12, 1920).

The basis for my assumption of the existence of neutrons, was that it would be difficult for α-particles, on account of their double positive charge, to pass through the region of repulsion (now called the potential barrier) around nuclei of high positive charge in order to unite with the nucleus, but that electrically neutral particles "could easily pass into and through this region". "Such atoms might have masses 1, 2, 3 and 4, and possibly other values, and they would contain no non-nuclear electrons, so they would have no chemical, and almost none of the ordinary physical properties, aside from mass."[2]

While the question of stability is not discussed in this paper, it may be stated that at that time I did not consider any neutron of higher mass than 2 to exist more than momentarily except in a moderately heavy nucleus, but that the first quadruple neutron present in other nuclei is that in argon 40, the nuclear formula of which may be written $\alpha_9{}^{++}(pe)_4{}^{\circ}$ or $\alpha_9{}^{++}(\alpha e_2)^{\circ}$.

Since neutrons of unit mass (according to Chadwick about 1·006), and possibly those of mass two also, probably exist throughout space, and are concentrated by gravitation in the planets, and still more in the stars, they may be considered to constitute collectively an element. Since the atomic number of an element is determined by the magnitude of the charge on the nucleus of an atom of the element, the atomic number which corresponds to a neutron is zero; that is, the neutron is a nucleus with a zero charge. As a name for this new element, neutronium, neutronon, or neuteron have been suggested to me, but the name 'neuton' is more simple and preserves in it the suggestion of neutrality and also the final 'on' of the chemically indifferent elements.

To what extent the atoms of neuton partake in the partition of heat energy between molecules in general, is an interesting problem, since the collisions of the neutrons would be with nuclei and with electrons, rather than with atoms and molecules.

It is not improbable that the general formula for any nucleus, $(p_2e)_z(pe)_i$, proposed independently in 1921 by Masson and by me, may be shown to have a theoretical significance. If n represents a neutron, then this formula may be written $(pn)_z n_i$ in which z is the atomic, and i the isotopic number. For the neutron z is 0 and i is 1, for the proton z is 1, and i is -1, for oxygen 16, z is 8 and i is 0, and for the principal isotope of argon z is 18 and i is 4. It is evident that if all of the electrons are present as neutrons, then $z+i$ gives the number of neutrons, z the number of extra protons, and $2z+i$ the total number of protons. The numbers z and i are the most important in the classification of atomic species, and the value of i defines specifically the particular isotope, either known or unknown, of any element, either radioactive or non-radioactive.

WILLIAM D. HARKINS.

University of Chicago.
Nov. 8.

[1] Harkins and Wilson, *J. Amer. Chem. Soc.*, 37, 1396; 1915.
[2] Harkins, *J. Amer. Chem. Soc.*, 42, 1996 and 1964; 1920.

Kinetics of the Decomposition of Molecules of Intermediate Complexity

IN a large class of gaseous chemical reactions, the mechanism is generally supposed to be the following. Molecules are brought into an activated state by collision. Most of the activated molecules are deactivated again, but during their existence there is a definite probability of their chemical transformation. As is well known, the relation between reaction rate and pressure under these conditions is such that the reciprocal of τ, the half life of the reacting substance, gives a curve of type 1 or 2 (see Fig. 1) when plotted against the initial pressure[1]. (The precise shape of the curve before it has become horizontal depends upon how the above mentioned probability varies with the total energy of the molecule[2].)

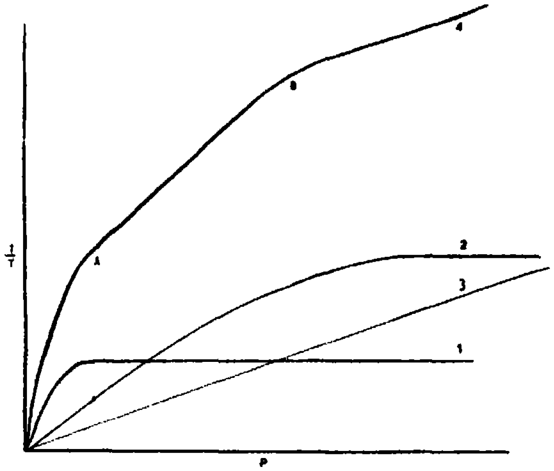

FIG. 1

In a molecule of moderate, but not too great, complexity, it seems possible that there may be several different modes of activation, corresponding to particular divisions of part of the energy among a limited number of vibrational (or rotational) states. To a first approximation, each of these modes may be associated with a separate probability of transformation, because, in the absence of collisions, internal redistribution may be difficult. Thus the total rate of reaction will be roughly the sum of several virtually independent reactions, each rate varying according to a curve of the type 1, 2, or 3. Since each of these reaches its limiting rate at a different pressure, the total rate may vary with pressure according to a segmented curve of type 4, with fairly pronounced changes of direction at A, B, and so on.

The simplest types of molecule may give curves which do not bend, at least up to high pressures, moderately simple molecules may give curves with a limited number of segments of decreasing slope, while complex molecules with many degrees of freedom give curves in which the segments merge into a single line without any noticeable changes of direction at particular stages.

The equation of the segmented curve in real examples will be very complicated, since the assumption of virtually independent reactions is to some extent an idealisation. Further, the variation of all the transformation probabilities with total energy may also complicate matters.

The object of this note, however, is simply (1) to suggest the desirability of exploring the hypothesis that the most general form of curve for molecules of 'intermediate complexity' is of the segmented type, and (2) to state that experiments on the decomposition of nitrous oxide at fairly low pressures (already published[3]) and further experiments on the decomposition of acetaldehyde (in progress) yield indications of the real existence of these different types of activated state.

C. N. HINSHELWOOD.
C. J. M. FLETCHER.

Balliol and Trinity College
Laboratory, Oxford.
Dec. 8.

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[1] Hinshelwood, "Kinetics".
[2] Rice and Ramsperger, Kassel.
[3] Musgrave and Hinshelwood, *Proc. Roy. Soc.*, A, 135, 23; 1932.

'Hexuronic Acid' (Ascorbic Acid) as the Antiscorbutic Factor

IN view of the facts that (1) hexuronic acid is the name of a class of substances rather than that of one individual compound, and that (2) the material described as hexuronic acid isolated from adrenal cortex and now from Paprika contains a molecule of water less than is required for a hexuronic acid, we wish to ascribe the name ascorbic acid to the crystalline substance $C_6H_8O_6$ which has been the subject of earlier communications from our laboratories.

A. SZENT-GYÖRGYI.
W. N. HAWORTH.

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Dec. 19.

Methylnornarcotine, Glycuronic Acid, and Vitamin C

THE view that vitamin C is identical with methyl*nor*narcotine has been advanced by Rygh[1,2], who claims that narcotine occurs in unripe fruit and disappears with corresponding formation of vitamin C during ripening. According to Rygh, guinea-pigs receiving a scurvy-producing basal diet together with a suitable daily supplement of synthetic methyl*nor*narcotine lose weight and die but without any of the typical symptoms of scurvy. Other workers[3,4,5,6] have been unable to confirm this observation or to find narcotine in unripe fruit, and Dalmer and Moll[6] have shown that methyl*nor*narcotine as prepared by Rygh is not a single chemical substance.

In a later communication Rygh[7] has changed his ground and taken up the position that vitamin C is a complex, of which one component must be methyl*nor*narcotine while the other may be any uronic acid. Thus according to Rygh, the recently demonstrated anti-scorbutic activity of hexuronic acid is due to the contamination of the hexuronic acid by methyl*nor*narcotine, giving a mixture of the two components necessary for the make-up of vitamin C. This hypothesis was drawn from the observation that guinea-pigs were not only protected from scurvy but also grew normally if in addition to the basal diet they received daily 10 γ of "30 per cent methyl*nor*narcotine" and ½ mgm. of glycuronic acid, although the glycuronic acid alone neither prevented scurvy nor supported growth.

I have attempted without success to confirm these observations, using a specimen of glycuronolactone kindly given by Dr. E. L. Hirst, and two specimens of "30 per cent methyl*nor*narcotine", one prepared by Rygh and the other prepared in this laboratory. Young guinea-pigs were fed upon a scurvy-producing basal diet, and given a daily supplement of methyl*nor*narcotine, or of glycuronolactone, or of both together, in the amounts specified by Rygh.[7] On the sixteenth day the animals were losing weight rapidly, so they were killed and examined for (*a*) hæmorrhage at the knee-joint, (*b*) rib-beading, and (*c*) suprarenal staining with dilute silver nitrate solution after Moore and Ray.[8] All those animals which had been receiving any of the supplements showed signs of marked or severe scurvy indistinguishable from the condition of the negative controls, while the positive control animals (which had received 10 gm. of cabbage daily) were free from scurvy. The lower jaws of all the guinea-pigs were removed for histological examination of the teeth, and full details of the experimental observations will be published elsewhere when this examination has been completed.

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Dec. 7.

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[1] Rygh and Rygh, *Z. physiol. Chem.*, **204**, 114.
[2] Rygh, Rygh and Laland, *Z. physiol. Chem.*, **204**, 105.
[3] Smith and Zilva, *Chem. Ind.*, **51**, 166.
[4] Grant, Smith and Zilva, *Biochem. J.*, **26**, 1628.
[5] Dalmer and Moll, *Z. physiol. Chem.*, **209**, 211.
[6] Dann, Forsyth, Harris, Mills and Innes, *Lancet*, **2**, 237; 1932.
[7] Rygh and Rygh, *Z. physiol. Chem.*, **211**, 275.
[8] Moore and Ray, NATURE, **130**, 997, Dec. 31, 1932.

Union of Pycniospores and Haploid Hyphæ in *Puccinia Helianthi* Schw.

THE discovery[1] that, in a heterothallic rust like *Puccinia graminis* Pers., or *P. helianthi* Schw., the transfer of pycniospore-containing nectar from a monosporidial (haploid) pustule of one sex to a similar pustule of the opposite sex induces the development of æcia in the pustule receiving the nectar has stimulated interest in the process by which the diploidisation is effected.

In the examination of free-hand sections of monosporidial pustules of *P. graminis* and *P. helianthi*, I have observed that usually two types of hyphæ protrude through the ostiole of a pycnium: (1) the stiff tapering slightly-curved paraphyses, which have been frequently figured; and (2) flexuous hyphæ which show considerable variation in length, diameter, regularity of outline, and a few other features. In some of the pycnia—probably the older ones—of a pustule, these flexuous hyphæ may show rather profuse development; in others, only a few of them, sometimes none, are discernible. They may be shorter, but usually they are as long or longer than the paraphyses, not infrequently two or three times as long. They may branch, but they rarely show septations. Some may be swollen at the tip. Occasionally a short spur or peg, of less diameter than a branch, juts out at a side or tip.

Several pycniospores in union with such hyphæ have been observed in sections of haploid pustules of *P. helianthi* in which the nectar had been previously intermixed, so that presumably both (+) and (−) pycniospores were present on the surface of each pustule and in close proximity to the protruding hyphæ.

Fig. 1 shows such a union. The pycniospore is empty; and the hypha has lost most of its cytoplasm. Presumably the nucleus of the pycniospore has passed through the connecting tube into the hypha and proceeded down it, to associate itself in conjugate relationship with some nucleus or the mycelium.

With regard to the short spurs or pegs on these hyphæ, it is assumed that a hypha of one sex, in response to the presence in its immediate vicinity of a pycniospore of the opposite sex, sends out a short tube to establish contact with that pycniospore.

A nucleus in the act of passing from a pycniospore into a hypha has not been seen, but empty pycniospores found connected by short tubes to these hyphæ furnish strong circumstantial evidence that nuclei migrate from pycniospores to these hyphæ by way of fusion tubes.

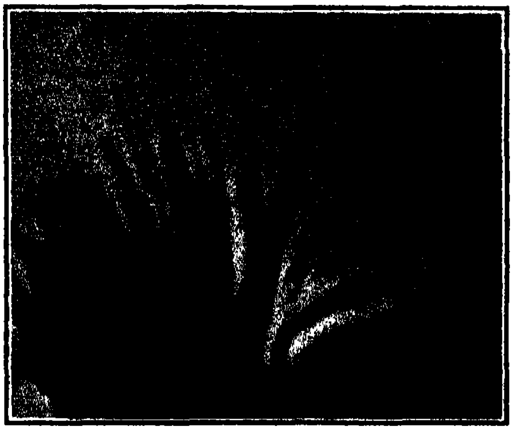

FIG. 1.—The union of a pycniospore and a flexuous hypha in a haploid pustule of *P. helianthi*. The pustule was fixed in formalin acetic alcohol 13½ hours after the intermixing of nectar was done. × approx. 1,500. Photograph by A. M. Brown.

Hyphæ which emerge through stomata and between epidermal cells were observed by Andrus[2] in haploid pustules of *Uromyces appendiculatus* and *U. vignæ*, and by Allen,[3] in haploid pustules of *Puccinia triticina*. Andrus regards these hyphæ as the tips of functioning trichogynes. Allen designates them "receptive hyphæ". However, neither of these investigators found direct evidence of fusions between 'spermatia' (pycniospores) and trichogynes or receptive hyphæ, although both assume from their studies that direct fusions do occur.

There is little doubt that, in haploid pustules of *P. helianthi* (or of *P. graminis*), the function of the protruding hyphæ is to establish contact between mycelia of one sex and pycniospores of the opposite sex and thus to serve as an avenue by which the nuclei of the pycniospores reach the internal mycelia of the pustules. The type of union so far observed simulates that of oidium and hypha in the Hymenomycetes.

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Dominion Rust Research Laboratory,
Winnipeg, Manitoba.
Nov. 17.

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[1] Craigie, J. H., NATURE, **120**, 765, Nov. 26, 1927.
[2] Andrus, C. Frederic, *J. Agr. Res.*, **42**, 559–587; 1931.
[3] Allen, Ruth F., *J. Agr. Res.*, **44**, 733–754; 1932.

Breeding of Oysters (*O. edulis*) at Port Erin

THE success obtained by the Department of the Ministry of Agriculture and Fisheries in breeding oysters (*O. edulis*) in the experimental tanks at Conway and Lympne[1] suggested that a similar use might be made of the large outdoor tanks or ponds at the Port Erin Marine Biological Station. In normal summers the sea temperature in Port Erin Bay rarely rises above 59° F. seawards of the beaches, owing to the steepness of the beaches and the mid-sea position of the Isle of Man; the maximum is reached at about the end of August[2]. The stagnant water in the ponds, however, follows air temperature much more closely than the sea, and this year gave surface readings during July and the first three weeks of August ranging mostly between 62° and 65° F.; a range favourable for oyster breeding.

In February, a hundred Whitstable oysters were imported into the Port Erin tank system and distributed on April 14 experimentally on the bottom in different outdoor tanks. These oysters were examined on July 20. High mortality had occurred in the east tank where about a hundred plaice had been stored for breeding. On the bottom of this tank it was found that there had become deposited a black sludge bearing a luxuriant growth of green weed. Oysters which occurred in places where this sludge had accumulated were suffocated. Somewhat similar conditions obtained in parts of the west tank, though the sludge was less dense and the loss was not so heavy as in the east tank. Only one individual, however, among twenty-five had died in a small clean outside store tank through which a small circulation of water had been maintained.

The oysters from this latter tank (24 in number) were opened on July 20, when two individuals were found black sick, that is, carrying larvæ ready to be voided from the parent into the water. On July 13 the east tank had been refilled with water direct from the sea after the pond had been scrubbed out. In this pond most of the larvæ taken from the two black sick oysters were distributed on July 20. To this tank had also been added about a hundred plaice stored for breeding experiments in the following year.

On November 24 the tank was emptied and examined for oyster spat. A sprinkling only was found. Sixteen were found attached to the north wall of the tank in underhung places along with balanids, mostly remote from direct sunlight. Three occurred in the full glare of daylight on the bottom and near the middle of the tank; one settled on a varnished board and one on a stone, both in deep water near the outlet pipe; two occurred on mussel valves also on the bottom of the tank. The bottom and lower parts of the walls of the tank were covered with a growth of long delicate green weeds, 98 per cent of which were *Cladophora fracta*, Kütz, var. *flavescens* Batt. (*C. flavescens* Harv.), along with a little *Urospora isogona* Batt. and *Percursaria percursa* Rosenv.; there was very little accumulation of black mud. It is probable that a good fall of spat might have been obtained had settlers or a supply of cultch been placed in the pond. The spat varied in size from 6 mm. long by 6 mm. deep to 20 mm. long by 18 mm. deep, and fell into two size groups, suggesting that two periods of settling occurred, possibly a settlement from each brood of larvæ.

Ordinary sea-water of a salinity about 33·5 per thousand[2] pumped into the tank direct from the sea was used in this experiment; the salinity probably varied little during the first month of the experiment, as this was a period of drought and a little fresh sea-water was pumped into the tank from the sea daily. The plaice in the tank were fed on boiled mussels, the remains of which would contribute with the waste products from the plaice themselves towards manuring the water for the growth of those micro-organisms on which the oyster larvæ and spat thrived. A heavy growth of green weed is evidence of considerable production of motile reproductive bodies from these plants. These reproductive bodies may very well have formed a portion of the food of the larvæ and/or spat at some period. Scott's investigations[3] on the plankton of these ponds in 1924–26 indicate that in July and August the phytoplankton (diatoms and dinoflagellates only) may normally be relatively scarce, or even absent: no plankton observations were made in 1932. A few *Gobius ruthensparri* and about four specimens of various species of small flatfish in the pond may have been inimical to a larger spatfall by feeding on the larvæ, as Dodgson and Sherwood[1] have found. 106 living plaice were recovered from the experimental tank in good condition on November 25.

The experiment is interesting in proving that under such meteorological and other conditions as prevailed in the summer of 1932, (*a*) oysters will spawn in the tanks at Port Erin; (*b*) the tanks are suitable for the production of young oysters; and (*c*) when the method of cultivating oysters in tanks has been improved so as to become a sound economic proposition, it may be possible in favourable summers to produce oyster spat in great numbers at Port Erin. The experiment also encourages the reasonable hope that such tanks as may be built in the future for mussel purification in the north of England may become as useful as those at Conway for oyster breeding.

We are indebted to members of the staff for taking valuable routine temperature records.

J. H. ORTON.
M. W. PARKE.
W. C. SMITH.

Zoology Department,
University, Liverpool.
Dec. 8.

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[1] R. Dodgson and H. P. Sherwood, Oyster Breeding Experiments; in Reports on Sea Fisheries, Ministry Agric. and Fish., England and Wales, 1919 *et seq.*

[2] J. R. Bruce, *J. Mar. Biol. Assoc.*, Plymouth, **15**, 542; 1928.

[3] A. Scott, *Proc. and Trans. Biol. Soc. Liverpool*, **39** and **41**, 1925–27.

Reversible Stoppage of the Blood Circulation in Sabellids

SABELLIDS are marine polychæte worms, the blood system of which is peculiar, both anatomically and physiologically. Numerous capillaries are present, in the body wall, in the branchial crown, and projecting freely into the body cavity, all of them ending blindly. Most of the blood vessels in the body contract rhythmically. By peristalsis blood is forced along the continuous vessels, and at intervals of 10–20 seconds blood is expelled from the blind capillaries by regularly rhythmic centripetal contractions of their walls, to flow back again into these capillaries almost immediately. There may thus be said to be a true Galenic circulation in the capillaries. The blood contains the respiratory pigment chlorocruorin.

If a sabellid worm is put, under water, into a narrow glass tube, the rhythmic contractions of the blood vessels in its crown can be seen through the glass. Under these conditions the contractions continue for half an hour and then cease. But as soon as even the tip of the crown projects again beyond the end of the tube, the contractions recommence. Thus when worms in Nature have retired into their tubes for over half an hour their blood no longer circulates. Yet *Spirographis* can remain uninjured for eight hours inside its tube when the front end of the latter is artificially closed. After about eight hours the animal re-expands its crown through a new anterior lateral aperture which it forms by local digestion of the mucoid tube.

When a sabellid is put into sea water saturated with carbon dioxide, the pulsations of its blood vessels cease almost immediately. After the animal has been put back into pure sea water the pulsations recommence. Neither water lacking dissolved oxygen, nor water acidified with hydrochloric acid to the same pH as water saturated with carbon dioxide, stops the pulsations. The threshold pH for stoppage in water containing carbon dioxide is in the region of 6·0, varying slightly with species.

It has been concluded from a variety of experimental evidence that the natural inhibition of blood circulation when worms are in their tubes is due to an accumulation of excreted carbonic acid between the filaments of the closed crown, and that this carbonic acid does not act on the blood vessels through a nervous reflex, but it prevents the normal exit of carbonic acid produced in metabolism, which accumulates in the body and has a direct inhibitory action on the blood vessel walls.

A full account of this work will be published shortly.

H. MUNRO FOX.

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University of Birmingham.
Dec. 6.

Photochemical Reaction of Hydrogen and Chlorine

I AM much surprised to read, in NATURE of December 17, that so fine an experimenter as Prof. A. J. Allmand has failed to inhibit the action of light on a mixture of hydrogen and chlorine, by drying. It is, with one exception, the easiest reaction with which to demonstrate the influence of traces of water on chemical action. So much so, that for many years it was one of my stock experiments in courses of elementary lectures.

Hydrogen and chlorine were generated by the electrolysis of hydrochloric acid, washed with water and conducted through a tube of phosphorus pentoxide for rough drying. The mixture then passed through a dozen thin bulbs blown in series on a tube of soft glass, in some of which had been placed phosphorus pentoxide. After about six hours, the wash water was saturated with chlorine, and half an hour later the bulbs were sealed off at their capillary joinings. The last bulb was exposed to the light of burning magnesium, and if it exploded after five seconds, the batch was assumed to be perfect. In lecture a pair of bulbs, one containing phosphorus pentoxide and the other not, were exposed to the same intensity of light and in no case did the dry gas ever explode, while the moist ones did so without exception. One of the dried bulbs was exposed to bright sunlight for three days, and analysis of the gas afterwards showed that one third of the mixture was still in the uncombined state. Mellor and Russell[1], in repeating this experiment, found that two thirds of the gas had resisted the action of light.

In describing these experiments to the Chemical Society, I did the experiment successfully; in fact, on the principle that 'seeing is believing' I have, almost without exception, demonstrated my results experimentally at the meetings at which the papers were read. Prof. Bodenstein and Prof. Allmand owe, I think, the failure of their experiments to the complexity of their apparatus. It is almost impossible, on account of the slowness of diffusion, to dry an apparatus which has any dead ends. Mere 'baking out' at 200° is insufficient, as I have shown over and over again, to get rid of deep-seated moisture in glass. Long continued contact of a gas with pure phosphorus pentoxide is the only way in which success can be attained.

At the risk of seeming egotistical, I would ask all who contemplate working in this field to read my paper[2] on "Manipulation in Intensive Drying". If they do so, they would, I feel sure, save themselves much fruitless effort.

H. B. BAKER.

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London, S.W.7.
Dec. 22.

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[1] *J. Chem. Soc.*; 1902.
[2] *J. Chem. Soc.*; 1929.

Limiting Mobilities of some Monovalent Ions and the Dissociation Constant of Acetic Acid at 25°

MACINNES, Shedlovsky, and Longsworth in reply[1] to our recent letter with the above heading[2] have asserted, without experimental evidence, that our conductivity technique was subject to errors and that the discrepancies between the results are to be attributed to this cause. We would, however, point out that by using the cell constant determined with 0·01 N potassium chloride by Parker and Parker's method[3] we have been able to reproduce Kohlrausch and Maltby's results[4] for KCl, NaCl, and KIO_3 at 18° over the range 0·0001 – 0·01 N to within 0·1 per cent,[5] and this, it appears to us, gives definite support to the view that our experimental results are trustworthy to at least 0·1 per cent.

Two limiting cation transport numbers for KCl are given in our paper[5], namely, 0·497 the old classical figure of Kohlrausch and Maltby[4], on which basis all limiting mobilities have hitherto been calculated, and 0·490 the most probable figure deduced from the results of MacInnes and Dole[6]. It was our original intention to redetermine this constant but owing to the transfer of the senior author to Woolwich, this project was abandoned. We now employ the figure 0·490, which appears to be the most probable value deduced from the determinations of MacInnes and Dole and of Longsworth[7]. The American authors state in their letter that their value for the limiting conductivity of the chloride ion, based on conductivity and also transport number measurements of KCl, NaCl, LiCl, and HCl at 25°, is 76·32 "within a few hundredths of a per cent"; the value deduced previously by us was $76{\cdot}4_5$ (n_k for KCl = 0·490).

The use of the empirical formula of Shedlovsky[8] for extrapolation to infinite dilution seems unnecessary: the ordinary square root formula holds over a considerable concentration range when applied to Shedlovsky's results[3] for KCl, NaCl, and HCl at 25°. Further, the Shedlovsky equation is of limited applicability (it breaks down for KNO_3, chlorates and iodates) and the values for Λ_0 deduced from it for NaCl and KCl at 18° have actually been exceeded at experimental concentrations by Kohlrausch and Maltby[10] and by Wieland[11] respectively.

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G. H. Jeffery.

University College,
Southampton.
Nov. 30.

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[1] Nature, 130, 774, Nov. 19, 1932.
[2] Nature, 130, 435, Sept. 17, 1932.
[3] *J. Amer. Chem. Soc.*, 45, 312; 1923.
[4] *Wiss. Abh. Techn. Reichsanst.*, 3, 156; 1900. *Ges. Abh.*, 2, 826; 1911.
[5] *J. Chem. Soc.*, 1715; 1931.
[6] *J. Amer. Chem. Soc.*, 53, 1357; 1931.
[7] *Ibid.*, 54, 2741; 1932.
[8] *Ibid.*, 54, 1405; 1932.
[9] *Ibid.*, 54, 1429; 1932.
[10] *Ges. Abh.*, 2, 886; 1911.
[11] *J. Amer. Chem. Soc.*, 40, 146; 1918.

'Raw' Weather

With the return of winter the following physico-physiological question once more calls for solution:—Very hot but dry weather may be tolerable, while moderately hot but very damp weather may be almost unbearable. The explanation of this in terms of cooling by evaporation is known to everyone. Again, while very cold dry conditions may be pleasant and invigorating, damp and rather cold weather—what is generally described as raw weather—is very unpleasant even to normal people, while it is peculiarly bad for those suffering from rheumatism and the like. So far as I know no explanation of this last effect has been generally accepted; indeed, inquiries of many physicists and not a few physiologists have failed to produce any suggestions regarding even the general lines along which a solution might be found. Any complete explanation must also account for the fact that damp air with a moderate temperature is far from unpleasant, as exemplified by the mild south-westerly conditions often occurring in the British Isles.

G. M. B. Dobson.

Robinwood, Boar's Hill,
Oxford.

Heat expands and softens the tissues, bringing more blood and lymph into the parts: cold tightens them up. It is, I suggest, this change which leads to pain in rheumatic people. A sudden thaw is most trying.

Cold moist air has a much higher conductivity than cold dry air, and acting on the skin produces the raw feeling and excites the nerve endings which reflexly cause the tightening-up effect.

The action of certain infra-red rays in producing reflexly congestion of the nasal air way or the opposite affords a striking example of how skin stimulation produces reflex effects on deeper organs.

Leonard Hill.

Isotope Effect in the Spectrum of Cadmium Hydride

In an earlier paper[1], I dealt with the structure of different band systems in the spectrum of cadmium hydride. In several respects, however, my analysis suffered from incomplete resolution of the spectrum, especially regarding the isotope splitting of the band lines. Recently I repeated the investigation, using a large concave grating in the third order (0·6 A./mm.). Much work was devoted to the analysis of an extensive system $^2\Sigma^* \rightarrow {}^2\Sigma$, covering a wide range of vibrational levels ($v' = 0$ to 13, $v'' = 0$ to 6) and thus forming a favourable case for an examination of the isotope effect. The band lines are here split into components belonging to Cd (114, 112, 110, 116), already known from the work of Aston.[2] Besides this, faint components appear belonging to isotopes Cd (118, 108), which have not been reported before. These components were found in every rotational line-group of a great number of bands, falling exactly in the position calculated ($\pm$ 0·02 cm.$^{-1}$). I was not able to detect the components of the odd isotopes Cd (111, 113), due to their positions between the intense lines of Cd (110, 112, 114). Only in favourable cases could a diffuse blackening be distinguished between the components of Cd (110, 112), which may be related to Cd (111).

There are some peculiarities regarding the intensity distribution among the isotope components which may be of interest to mention. In bands belonging to the transitions $v' \rightarrow 0$, the lines of Cd (114) are somewhat more intense than those of Cd (112), while there is a considerable intensity difference between the lines of Cd (110) and Cd (116), in agreement with Aston's values. In transitions $0 \rightarrow v''$, the intensity distribution is changed in favour of the heavier isotopes. Due to this, I was able to trace Cd (118) only in the latter case, where it appeared stronger than Cd (108), while in transitions $v' \rightarrow 0$ only Cd (108) could be observed. These relations can be accounted for partly[3] by influences of the Boltzmann factor $e^{-h\nu/kT}$.

Detailed account of the analysis of this spectrum will be given shortly.

Erik Svensson.

Laboratory of Physics,
University of Stockholm.
Nov. 24.

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[1] E. Svensson, *Z. Phys.*, 59, 333; 1930.
[2] F. W. Aston, *Phil. Mag.*, 49, 1191; 1925.
[3] G. Stenvinkel, Nature, 126, 649; 1930.

Chlorination of Sodium Benzoate

The chlorination of benzoic acid in alkaline solution by means of sodium hypochlorite is often quoted as an example of the effect of ionisation on orientation. Lossen's experiments[1] have been repeated, and it is now found that the product of chlorination contains 48 per cent ortho-, 32 per cent meta- and 20 per cent para-chlorobenzoic acid. This is an unusual type of orientation.

J. C. Smith.

The Dyson Perrins Laboratory,
University, Oxford.
Dec. 14.

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[1] Friedländer, 7, 115; 1903.

Research Items

Burial of a Bari Rain-maker. The burial of a rain-chief in the Bari country, Mongalla Province, Sudan, is described by Mr. A. C. Barton in *Sudan Notes and Records*, vol. 15, pt. 1. The rain-maker's last illness took place during a drought, and, as was ascertained by the performance of a special rite, had been caused by a more powerful rain-maker, who attributed to him the failure of his own efforts to bring rain. The grave was of a special type reserved for rain-makers, chiefs and influential freemen. It lay from east to west, and from the west, descent to the bottom of the excavation was by two steps cut in the earth. The interment chamber proper was cut laterally and frontally into the north and east sides of the excavation. The funeral ceremonies began with secret rites, to which only the close kin were admitted, in the house, which was closed immediately after death. These rites included the shaving and anointing of the corpse, the hair being placed in a calabash to be disposed of later in the bush. At the graveside, women who had not been present inside the house again anointed the body over its clothes, and the sons after anointing the back of the corpse down to the waist, again over its clothes, with ground and burnt semen returned to the house, observing a grass taboo, in walking, where they remained until earth had been thrown into the grave. A small son of a serf had been chosen as a serf of the dead, and when the corpse had been laid to rest in the chamber as on a bed, this boy remained by the corpse until it opened in final decay, when he came out of the grave and proclaimed the chief really dead. Large slabs of stone, sacking, etc., blocked the entrance of the cavity, so that no earth could fall on the chief, and above the grave were placed carved grave stakes, of which one had two prongs, a 'male' and a 'female', while the smaller is the 'sentinel'. These were brought from the father's grave and will remain on the chief's grave until required for his son's burial. A mourning feast and dance follow the burial.

The Malabar House. In commenting on a ballad of Kerala in the *Indian Antiquary* for November, Dr. M. D. Raghavan appends some notes on the Malabar house, which is highly conventionalised in plan and clearly has retained its main features unchanged for a very long period of time. The most characteristic dwelling-house of Kerala is called *nâlu-pura*, literally 'four-houses', being built round the four sides of a courtyard which is open to the sky, each room being named relatively to its situation with regard to the courtyard, that is, southern room, northern room or the three western rooms. Every house, however small, is regarded conventionally as a *nâlu-pura*, and hence a house of the smaller type, though facing east, is called *paḍiññâṟṟa pura*, that being the western block consisting of three rooms with a verandah in front. Usually behind the central room of the western block there is a small room called the 'lean-to'; and beside the inner verandah is an outer verandah with a long ridged roof on a beam supported by high pillars. The central of the three western rooms is the principal room of the house, containing the valuables and sacred to all household ceremonies. The main entrance is through a portico which serves the purpose of a drawing-room. Each house stands in a compound of its own, which is thickly planted with trees, and is enclosed by a massive bank of earth. A broad smooth walk, well rammed and plastered with cowdung, leads to the courtyard, of which the surface has been treated in the same way. The courtyard is used for drying paddy, pepper, etc., in the sun. It serves as a threshing floor, as the recreation-ground of younger members of the family, as an exercise ground in the use of arms, and as a place for ceremonial and social functions.

Facial Growth in Children. "Facial Growth in Children", by Corisande Smyth and Matthew Young (Medical Research Council. Special Report Series, No. 171), gives the results of a study of twenty characters of the face in 1,400 London children. The primary object of the investigation was to establish standards of normality. Measurements were made of some 1,200 selected children aged 8–14 years in the London County Council schools, 100 boys aged 9–10 years taken at random from a group of boys of the same age, and 100 children aged 2–5 years attending a welfare clinic. No measurements were made of children aged 5–8 years. This study confirms the findings of John Hunter, Tomes and Bolk that the dental arch does not increase in length after complete eruption of the milk teeth, but Smyth and Young find there is a definite increase in breadth of the dental arches after four years of age. As regards inter-relationships of the facial measurements, the most interesting result is the high association between the zygomatic breadth and breadth of the dental arches, an association denied by Korkhaus and other observers. There appears to be some tendency for a narrow face to be associated with a high palate but not necessarily with a narrow dental arch. Although all the results are based on selected children, that is, on those in whom normal occlusion has occurred, Smyth and Young consider they may be taken as fairly representative of London school children because of the close agreement found in the results for two groups of boys aged 9–10 years, one group selected because of normal occlusion, the other taken at random from the London schools.

Influence of Living-Space upon Growth. In the course of two years, experiments, fifteen in number, have been carried out by Dr. Jan Podhradsky with the object of deciding whether the size and shape of the living-space influenced in any way the growth and development of tadpoles of *Rana fusca* (*Bull. de l'Instit. Nat. Agron. Brno*, CSR., Sign. C. 20, 1931). It was found that size of living-space had a bearing on growth and development so that they followed their normal course only within certain limits of space, above and below which growth was depressed. In a small living-space the adverse factor appeared to be mutual disturbance amongst the tadpoles; in a large living-space the isolation of individuals seemed to be largely responsible. Shape of living-space also had a measurable influence: narrow and high vessels depressed growth because they enforced and exaggerated vertical movements on the part of the tadpoles and caused greater reciprocal disturbance, as well as allowing only a low absorption of oxygen at the surface. These effects were intensified with the growth of the tadpoles. It was found also that abnormally low water depressed growth and development, and this relation was thought to be due to the unusual accumulation of excretory products and the fouling of food.

Age and Growth of Limpets. N. Abe (*Science Reports*, Tôhuku Imp. Univ., vol. 7, No. 3, 1932) has shown that colonies of *Acmæa dorsuosa* formed in spring and summer break up in autumn and winter but the individuals do not migrate more than 5–6 metres and hence are subject to the same environmental conditions every year. He has measured the individuals of such colonies and also other examples in which the shell clearly shows the annual rings. In limpets which live in wet places the growth-rate is greater, the thickening of the shell is slower and the height of the shell is relatively less than in those from a drier locality. The ratio of breadth to length of the shell is practically constant in individuals more than three years old. The weight of the shell is greater than that of the body (soft parts) in the proportion of 1 : 0·8. The frequency distribution of age in the colonies is asymmetrical; individuals of four years of age are most numerous. Specimens older than twelve years are few and it would appear that the maximum age of this limpet is about seventeen years.

Style-Sac of Gastropods. R. V. Seshaiya (*Rec. Indian Mus.*, vol. 34, pt. 2, 1932) notes that a crystalline style and style-sac have been recorded in ten families of prosobranch gastropods, and he now records them in two more families—Cerithiidæ and Assimineidæ. He refers to Randles' description (1902) of the posterior chamber of the stomach of *Turritella* in which the presence of a single fleshy fold and a crescentic groove is recorded, the groove being considered to be a vestigial cæcum and a very primitive feature. The author's examination of the stomachs of *Turritella* and of several other style-bearing gastropods does not support this view. The groove and the adjoining ridges or folds are functional structures and serve to accommodate the gastric shield and to direct the gastric contents towards the style.

Nutritive Value of Pastures. The fact that pastures which appear very similar may differ widely in nutritive value (stock-carrying and fattening capacity) has long remained without a satisfactory explanation, and an investigation of the problem has been made by E. J. Sheehy (*Sci. Proc. Roy. Dub. Soc.*, vol. 20). So far as the chemical composition of the dry matter of the organic portion of the herbage is concerned, no consistent difference was observed between good, mediocre and poor pastures in the same neighbourhood, and although a slight inferiority in the phosphate content of the inorganic portion did occur in the poorer herbage, the disparity was not large enough to account for its reduced feeding value. Further, the chemical composition of the dry matter of fiorin grass and plantain grown on soils carrying pastures of very different value, remained unaffected. The digestibility of such different types of pasture plants as perennial rye grass, Yorkshire fog and plantain were also found to be very much alike, so that differences in nutritive value could not be explained on this score either. The factor which proved to indicate the value of the pasture, however, was the percentage of dry matter, and in consequence the density of the sward is an important feature. The latter is largely determined by the botanical personnel, the narrow-leaved grasses yielding a higher dry weight per unit area than broad leaved plants such as weeds. Clovers occupy an intermediate position. Fattening capacity is, therefore, definitely related to the dry matter content and density of the herbage, but stock-carrying capacity is also affected by the rate of growth, as upon this property the provision of abundant feed depends.

Identification of Indian Sleeper Woods. In *Forest Bulletin* No. 77 (Economy Series, of the Forest Research Institute, Dehra Dun, 1932) Mr. K. A. Chowdhury, wood technologist, has produced a most useful little guide to enable forest officers, railway passing officers and others to identify on the spot some of the more common Indian sleeper woods. This bulletin is the first of its kind. Capt. Trotter in a preface says that it is hoped to publish similar bulletins from time to time dealing with timbers of individual provinces, that is to deal with timbers according to localities rather than uses. In the present case that method of treatment would not have been so useful, as the map appended to the bulletin well illustrates. This map "shows the various species of sleeper woods that grow in the areas in which different railway groups are concerned". These groups are five in number, namely, Northern, Central and Terai, Eastern, Southern and Burma. The map serves two purposes—the first and most obvious, the species which can be obtained from a given locality, and the second and the more striking, it can help in identification, as a species may easily be eliminated which does not occur in a particular locality. A few simple details on wood structure and so forth lead up to the key for the identification of more than fifty species of important Indian sleeper woods. This key is drawn up in the simplest fashion and appears to be easily workable, but as the author states, "quick and accurate identification of timbers can only be achieved after much practice". A sharp knife and a hand lens magnifying 10–12 times are all that are required to assist the key. Incidentally, the bulletin serves once again to show the importance to India as a whole of the research work being carried out at Dehra Dun in connexion with the enormously valuable Indian forest estate.

Spectroscopic Detection of Small Quantities of Elements. The *Wiener Berichte* IIb 141 contains a paper by W. Späth on the detection of very small quantities of elements by the spectroscope. Droplets of solutions were evaporated on silver or copper electrodes and the spectra were excited by condensed spark or by a break-contact arc, according to whether spark or arc lines are the more persistent in a particular case. The preparation of very pure silver electrodes was a long and troublesome matter, and the methods finally adopted are described in considerable detail. 10^{-10} gm. of cadmium was the smallest quantity which could be detected, using the arc line 2288 A. and the spark line 2265 A. In experiments with other metals, 10^{-10} gm. manganese, 10^{-7} gm. arsenic, 10^{-7} gm. tellurium, 10^{-9} gm. lithium and 10^{-11} gm. strontium could be detected. The limit is apparently set by the presence of a continuous background in the spectra which masks very faint lines, and it is suggested that a spectrograph with higher dispersion combined with high light gathering power would enable yet smaller masses to be detected.

Low Temperature Carbonisation of Coal. In accordance with the policy adopted by the Government some years ago, the Department of Scientific and Industrial Research has examined the Turner plant for the low temperature carbonisation of coal installed at the Comac Oil Co. Ltd., Coalburn, Lanarkshire. The report on the test issued by the Department (H.M. Stationery Office, 9*d*. net) shows that the retort is of the continuous vertical type, internally heated by superheated steam. A peculiarity is the use of a fluctuating pressure claimed to facilitate transfer of heat from the steam to the coke. From 1 ton of coal were obtained 13·4 cwt. of coke, found to be a good domestic fuel, 21·3 gallons of tar and spirit, 2,170 cub. ft. of gas of total heating value 18·7 therms, and 334 gallons of liquor of no value, although as an effluent it must be regarded as a distinct liability. The alternations of pressure are regarded as a necessary feature of this process, but tests made with the plant adjusted to give steady and fluctuating steam pressures to the retort gave substantially the same results.

Dewaxing and Acid Refining Mineral Oils. At a Congress of Polish Petroleum Technologists two years ago, the De Laval *S–N* method of dewaxing was for the first time made public. The data then were based principally on tests with Polish oils from Schodnica and Urycz. Tests were being carried out on a small plant, but since that time a larger centrifugal separator has been employed successfully, and it has been possible to treat pipe-still distillates in addition to those produced by other methods. An account of this process was given by Dr. Nils Olof Backlund on December 13 at the Institution of Petroleum Technologists. Among interesting points made was the substitution of trichlorethylene as a more suitable solvent for separating the wax from the oil than the time-honoured benzene. Rate and degree of cooling of the oil-solvent mixture are of the utmost importance to the process. The advantages of the De Laval *S–N* trichlorethylene method compared with the benzene method include a smaller quantity of solvent used, a shorter period of cooling and the possibility of working at higher temperatures. Particulars were also given regarding acid treatment of petroleum products, and it was concluded that this process had not reached an entirely satisfactory stage. Fundamentally, acid treatment still remains a 'discontinuous process', and suffers from the disadvantages thereof when compared with efficiency of distillation, dewaxing and cracking in continuous plants. The author pointed out directions in which modernisation of acid-refining is desirable and gave an account of the De Laval *S–N* acid sludge separator, which represents a definite advance on anything so far designed. The main importance of this process, however, would seem to be in the field of lubricating oil refining, where it is destined to effect considerable economy in production costs.

Astronomical Topics

Astronomical Notes for January. Mercury can be observed as a morning star early in the month; Venus is also a morning star, but far from the earth, and approaching superior conjunction; its disc is almost fully illuminated. Mars is approaching opposition, and is visible for most of the night; this is an aphelion opposition; the diameter on March 3 will be just under 14″. Jupiter also reaches opposition in March, and will be near Mars for some months. Saturn is in conjunction with the sun in January; Uranus is still observable in the evening. Neptune is well placed for observation in the middle of Leo.

A star of mag. 5·6 is occulted by the moon on Jan. 9, disappearing at 8.28 P.M. κ Geminorum (mag. 3·6) disappears at 10.50 P.M. on Jan. 11, reappearing at 11.24, angle 221°; the moon is full on that day.

The following are the positions of Comet Dodwell-Forbes at the beginning of Jan. 14 and 24, according to the Whipple-Cunningham orbit:

Jan. 14 R.A. $0^h38^m34^s$ S.Decl. 4° 52′; Jan. 24 R.A. $1^h15^m4^s$ N.Decl. 4° 43′.

Comets Faye and Geddes may also be seen with moderate telescopes; there are ephemerides in the B.A.A. Handbook for 1933.

There are minima of Algol at convenient times for observation on Jan. 8 at 7.54 P.M. and on Jan. 28 at 9.42 P.M.; a full table is given in B.A.A. Handbook.

Mass of Eros. Soon after the announcement by W. H. van den Bos and W. S. Finsen that Eros appeared like a figure-of-eight in the 26½ in. Johannesburg refractor in January 1931, Prof. W. H. Pickering derived the mass of Eros on certain assumptions as to its figure. Dr. Knut Lundmark has made a further investigation based on the same material (*Lund. Obs. Circ.*, No. 7). The diameter of Eros was taken as 23·4 km., and it was supposed to consist of two spheres in contact, each having a radius of 5·85 km.; the reciprocal of the mass in terms of the earth is 259,900,000. This gives a density only a quarter of that of the earth. If the distance of centres is increased to 18·6 km., the density becomes equal to that of the earth.

Comets of A.D. 868 and 1366. It was established by Dr. Hind that the second of these comets is in all probability identical with Tempel's Comet, 1866 I, associated with the Leonid meteors; Hind thought that the comet of 868 might also be identical with it. The *Japanese Astronomical Herald* for October, 1932, contains a re-investigation of the orbits of these two comets, by Dr. S. Kanda, based on the original observations; for the first comet he used observations made in Japan, Europe, and Korea; for the second he does not appear to have found any further observations than those used by Dr. Hind, and the new orbit is quite close to that of Hind.

T	868 March 4	1366 Oct. 18·54 U.T.
ω	277°	164·8°
Ω	305	218·5
i	65	149·8
q	0·42	0·9749
e	1·00	0·9059
Period	—	33·35 years (assumed)
Equinox	868·0	1366·0

It may be concluded that the first comet is not identical with Tempel, but that the second probably is identical. This identity had been assumed by the Computing Section of the British Astronomical Association in investigating the perturbations of the comet from 1366 until 1932. Search ephemerides are given in the B.A.A. Handbooks for 1932 and 1933.

Electricity, Gas and Other Fuels as Heating Agents

IN a paper read by Mr. A. H. Barker to the Institution of Electrical Engineers on December 1, an explanation was given of the conditions under which electrical power can be used competitively for the heating of buildings. It is well known that, reckoned on the heat unit basis alone, electricity is the most expensive of all the sources of heat in common use, and that comparatively, gas is at present not very far behind it. Since the heat in a gas company's therm equals 29·4 electric units, it follows that if gas cost 6*d*. per therm and electricity 0·5*d*. per unit, the cost of the crude heat per therm delivered by the gas company would be 6*d*. and by the electric company 14·7*d*. In a few years' time we hope that more companies will be supplying at these cheap rates. If the thermal electric storage were employed the price of the electric heat would be reduced by about forty per cent. With oil at 80*s*. a ton and coke at 40*s*. a ton, the costs would be 2·25*d*. and 1·64*d*. a therm respectively. Looking merely at the costs of the 'crude' heat, the solid fuels are much cheaper.

The most fundamental difference between gas and electric heat is that with the former it is purified fuel which is transported to the spot where the heat is required, while with the latter it is energy only. There are three points arising from this. The street main is much larger and more difficult to accommodate with gas than with electricity but the house-pipes for gas are smaller and cheaper. In order to convert the gas energy into heat, it has to undergo the process of combustion with the disadvantages of high temperature and waste products of combustion. The use of gas causes less actual destruction of fuel than electricity and the heat from it is therefore cheaper. Gas is in fact crude fuel which has had all the ashes and smoke purified out of it at the sacrifice of the manufacturing costs and about twenty per cent of the energy of the crude fuel. Electricity carries the purification a stage further. In its manufacture, everything, including all the labour, is purified out of the fuel but there is a loss of about twenty per cent of the energy in the mains. There are obviously cases, where so far as its usefulness is concerned, this further stage of purification is a pure waste of money, just as it is a waste of money to soften water needed for sanitary fittings.

In Mr. Barker's opinion, gas and electric supply have each their own sphere of usefulness, in which one is either economically or functionally superior to the other. There is only a small area of supply in which reasonable competition is legitimate. Both industries ought to be amalgamated, in their own and in the public interest. It is very difficult to assess the money value of their relative advantages and disadvantages in each particular case.

Apart from its cost, electrical energy is almost an ideal means for room warming. By its agency, pure heat can be delivered through light and flexible wires in any quantity, at any temperature and in any desired form to any particular spot. Turning on and off involves nothing but a mechanical motion of a switch and this can be readily done automatically by a simple and trustworthy form of thermostat. The use of any other fuel gives, along with the heat, products of combustion of a more or less deleterious nature. It is only in very special cases that heat derived from the combustion of fuels can be employed without the use of chimneys.

Gas possesses the advantage that it can be exactly regulated to requirements. It can be conveniently stored so that a sudden overload need not affect the supply. Breakdown is less probable than with the more complicated electrical plant. In some cases when combustion is effected completely, the products are innocuous and so can be allowed to mix with the air of the building and so secure—like the electrical fire—an efficiency of one hundred per cent. The drawbacks are that gas needs to be ignited and supplied with air before the heat can be developed. It has an objectionable smell and is dangerous if it escapes or is incompletely burnt.

The advantages of oil are that it is fluid and so can be pumped with little smell or trouble into a tank through a pipe-line. It is much easier to ignite, to regulate and to extinguish than coke, though more difficult than gas. It is very clean in operation, and when properly burnt highly efficient. Owing to the high degree of the combustibility of oil, there is a good deal of potential danger attached to it. It is apt also to give off smoke and odorous fumes. The advantages and disadvantages of coke and other solid fuels are well known. For example, they will allow any sort of combustible material to be destroyed in the furnace. It is probably the most economical form of heating but it involves greater labour than any other fuel. It produces dust, is dirty to deliver and clumsy to handle.

Mr. Barker deals exclusively with the cost of the fuel and the labour involved in handling it. When the heating required is intermittent, both electrical and gas heating have advantages over the other fuels.

Mesolithic Age in Britain*

IN 1926 the Royal Anthropological Institute held an exhibition illustrating the microlithic industries of Britain, to which all who were then known to be interested and engaged in forming collections of implements of this phase of the Stone Age were asked to contribute. The mesolithic period had been somewhat neglected by British archæologists; and it is probable that it came as a surprise, even in archæological circles, to find how considerable was the amount of material which it had been possible to get together and the increase in the interest taken during the early years following the War in these remarkable products of man's skill and ingenuity.

In the period which has elapsed since that exhibition was held, further progress has been made in the study of the mesolithic age, and the time was fully ripe for a detailed discussion of the position of microlithic industries in relation to preceding and succeeding cultures. The opportunity for such discussion was afforded by a series of papers in the programme of Section H (Anthropology) when the

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*Based on certain papers read before Section H (Anthropology) of the British Association at York, September 6, 1932.

British Association met at York last summer. The conditions were exceptionally propitious, as not only were there within reach of York sites of sandy heath typical of the geographical environment preferred by Tardenoisian man, upon which, moreover, numerous finds of implements had been made, but also the fact that Mr. J. G. D. Clark was to open the session with a paper on the mesolithic age in Britain ensured that the otherwise preponderating attention to be given to the north of England in this series of communications would be placed in proper perspective.

The advances which have been made in the study of the typology of mesolithic implements now make it possible to work out the geographical distribution of characteristic forms with a relative certainty, if not with an absolute precision, while a number of pregnant suggestions emerges as to their derivation and development. Thus Mr. Clark holds that, while the Upper Palæolithic industries of Britain already showed microlithic tendencies, the Tardenois culture is to be regarded as intrusive in both its first and second phases, and late Tardenois, though in all probability a local development in its British manifestation—the 'trapezoid' implement is said to be peculiar to Britain—also has indications of continental influence. Thus in the Pennines the 'broad blade' industry, the non-geometric Early Tardenois industry, is certainly of continental derivation, while the Middle Tardenois, which extended as far as the Isle of Man, points to Belgium. At the same time, the view thus taken of late Aurignacian industries must be kept in mind in considering sites which show a sequence of cultures, such as those described by Mr. A. L. Armstrong.

The study of types leads Mr. Clark to divide Britain into two provinces, of which Province *A* is characterised by the absence of the tranchet axe or pick, while the microliths are present both in the early non-geometric forms and in the later geometric forms, some of them of extremely small size. In Province *B*, the south-east of England, on the other hand, the tranchet axe is found, but the place of the geometric forms of Tardenois industry is taken by the still surviving non-geometric forms.

In the working out of the sequence and relation of the phases of Tardenois cultures, the investigations of Mr. F. Buckley in the Pennine chain are especially significant, although the whole chain has not been covered and his conclusions are drawn only from certain selected sites, such as Standedge Ridge, Yorks, where the whole chain narrows down to a single ridge, along which mesolithic man must have passed in avoiding the valleys. Various mesolithic sites under the peat have been excavated. These sites contain the relics of two distinct peoples or races of Tardenois folk. Of these one is known as the folk of the 'broad blade' industry, the other as the people of the 'narrow blade' industry. The implements of the former are predominantly of the non-geometric type and include many pointed blades, while among those of the latter are numerous small geometric tools. This people used open-air encampments and wandered freely over the hills; but the 'broad blade' folk travelled along the watershed ridge and erected huts or wigwams on their camping sites. The hearths have yielded wood remains, giving some data as to tree distribution in mesolithic times.

An important contribution to the discussion of mesolithic problems, comprehensive in its view, was made by Mr. A. L. Armstrong's account of his investigation of the Tardenois and pre-Tardenois cultures of north Lincolnshire in the light of evidence afforded by a number of sites in that area. Here a series of stratified sections and occupied sites exhibits a continuous sequence of industries, embracing the Upper Palæolithic and the whole of the Mesolithic periods. Mr. Armstrong has recently discovered Aurignacian flint implements in glacial gravels at Hardwick Hill, east of the Trent. These are heavily rolled, owing, it is suggested, to the wave action of an estuary or glacial lake, and point to the existence here of palæolithic man before the last glaciation—possibly a band of hunters who had penetrated the swamps and taken up their residence on the dry uplands of the Cliff Range and, probably, also on the Wolds. They appear to have inhabited this region through the last phases of the glacial epoch and to have remained until the appearance of mesolithic peoples, the Azilian and Tardenois. The latter eventually dominated Lincolnshire, according to the indications of a number of stratified sites.

Of these sites the earliest is a late-Developed Aurignacian (Creswellian) station, discovered by Mrs. E. H. Rudkin, and excavated in February last, on the western escarpment of the Lincolnshire cliff above Willoughton. At Sheffield's Hill, near Scunthorpe, a similar occupation site, but of later date, gives evidence of the final phase of the developed Aurignacian, upon which early Tardenoisian was imposed. At Risby Warren, Scunthorpe, where systematic researches have been carried out for eleven years, there is stratified evidence of occupation levels ranging from developed Aurignacian, which is quite free from Tardenois influence, to the earliest neolithic, full neolithic and bronze ages. The Tardenois culture is represented by several horizons and can be classified broadly as early and late. This site, Mr. Armstrong claims, in virtue of its abundance of stratified material and its numerous occupation zones, representing the whole of the Tardenois period, is to be regarded as the type station of Tardenois culture in England.

University and Educational Intelligence

WALES.—The University Court at its meeting on December 15 decided to award the degree of D.Sc. *honoris causa* to Prof. Francis Ernest Lloyd, professor of botany in McGill University, and Prof. Robert Robinson, Waynflete professor of organic chemistry in the University of Oxford.

THE Institute of Sociology, Le Play House, 65 Belgrave Road, London, S.W.1, has now been incorporated as a company limited by guarantee. This is the final step in a scheme for permanently establishing and endowing the Institute, which was initiated in 1920 through the generosity of the late Mr. and Mrs. Branford. Under an order of the Chancery Court, the whole of Mr. Victor Branford's estate, subject to the temporary reservation of a portion for the benefit of relatives, passes to the Institute. The present officers of the Institute are Dr. R. R. Marett (president), Rector of Exeter College, Oxford; Mr. C. H. Rigg (honorary treasurer), and Mr. A. J. Waldegrave (chairman of council).

Calendar of Nature Topics

January freeze-the-pot-by-the-fire

January, the coldest month of the year in England, is proverbially associated with snow and ice. In the French Revolutionary Calendar of 1793, the period from December 21 to January 19 was the month 'Nivôse' or 'snowy'. During the twentieth century, however, January has not lived up to its name, but has been much more open, mild and stormy, with few prolonged frosts. At Greenwich the mean January temperature during the decade 1921–30 was 41·3° F., more than 2° F. above the long-period normal and probably 5° or 6° higher than in some of the decades of the late eighteenth and early nineteenth centuries. This persistent period of mild winters has extended over the whole of western and central Europe; it is associated with a greatly increased frequency of south-westerly winds and may almost be regarded as a change of climate.

Life in the Southern Atlantic Ocean

"January 1—Wilson's petrels, two kinds of prion petrels, albatrosses and a bosun bird were observed to-day. Sun-fish (*Orthagoriscus mola*) were also seen; at 2.30 p.m. a boat was lowered to get one. After several ineffective attempts at harpooning we managed to stun one with shot. Davidson after a while drove the harpoon into the gills, and we then made fast to one of its fins and towed it to the ship. Three or four sucker-fish accompanied it to the boat, and on cutting the sun-fish up, one was discovered in the gills. A parasitic copepod (*Argulus*) was found externally, as well as a polyclad. There was also a parasitic copepod on the gills and a barnacle on the lip. In the intestines numerous tape-worms were found and another leech-like parasite. There was in all probability about 10 lbs. weight of tape-worms in the gut. Its weight by the dynamometer was half a ton. Several others were seen twice as large. Brown saw a globe-fish with a small fish attendant on it. *Salpa* were seen frequently floating past." From "Zoological Log of S.Y. *Scotia*", on January 1, 1903, in lat. 39° 01′ S.; long. 53° 40′ W.

The lethargy of the sun-fish has often been referred to. The individual mentioned above, now exhibited in the Royal Scottish Museum, Edinburgh, was regarded by its captors as a tiny specimen compared with others seen the same day "about the size of a small haystack", and of it they said, "Its stupidity was amazing; unable to swim faster than a boat could row, all it had to do to escape was to sink—and this they can do quite well,—but although struck by a harpoon a dozen times before one held, it made no attempt to escape. . . . When cut up it was easily seen why the first harpoons would not hold, as under the skin was a layer two or three inches thick of a hard cartilaginous material. The dissection was performed mainly with axes. The central nervous system was very interesting on account of its minute size relative to the body, the spinal cord being only about half an inch long and barely coming outside the cranial cavity. This degeneracy is doubtless correlated with the feeble musculature and swimming powers. Intelligence and mobility have become superfluous, the size and thick hide being sufficient protection against most enemies." From "The Voyage of the *Scotia*", by R. N. Rudmose Brown, R. C. Mossman, and J. H. Harvey Pirie.

Hurricanes of the Southern Hemisphere

January 7.—The greatest frequency of hurricanes or revolving storms in the southern hemisphere occurs about the second week in January, though they may be experienced at any time during the southern summer. Four areas are subject to these storms, the islands of Polynesia, especially the Samoa, Fiji and Tonga groups, the Coral Sea between Queensland and the Fiji Islands, the north-west coast of Australia and the South Indian Ocean between the Chagos Archipelago and Madagascar. The Australian storms are locally known as 'Willy-willies', and in addition to causing loss of shipping, frequently result in disastrous floods. The majority of the hurricanes in the southern hemisphere originate between lat. 5° and 15° S., travel at first towards west-south-west, recurve in about 20° S. and finally pass away to the south-east, decreasing rapidly in intensity.

"Furze or Gorse (*Ulex europæus*) flowering"

This record made by Gilbert White at Selborne on January 8 is a reminder of the winter activity of gorse which makes it an important item in the economy of the countryside. The closely cropped conical bushes, which in many places dot a pasture like old-fashioned bee-hives, are evidence of the part it plays in the winter food-supply of rabbits and sheep. Before roots were commonly available for the winter feeding of farm stock, gorse partly took their place: "The sowing of whins for feeding of cattle takes mightily about London just now [1725] . . . this improvement comes from Wales, where it has been practised these hundred years." In Scotland rough whins from waste ground were used in place of the more tender sown crop, and these had to be broken and pulped before being served to the cattle. The apparatus used was a cumbersome whin-mill, the essential part of which consisted of a huge stone roller dragged by an ox or a horse round a paved circuit, upon which the whins were laid. Remains of such whin-mills are still to be seen at occasional farmhouses in Scotland, although whins have long since dropped out of use. In the south of Ireland, however, on hillside farms where hay is scarce, whins are still used for feeding horses during the winter months. The seed is sown on spare ground, and the crop, cut in the following year, is passed through an ordinary chaff-cutter before being served.

The Hibernation of Frogs

In early January 1932, Francis B. Bent (as recorded in the *Observer*, May 1, 1932) emptied a pond and cleaned it out. The pond was ten to fifteen feet deep and the normal depth of water was four feet, but in the clay ooze at the bottom there were discovered thirty or forty frogs. In the same month H. C. Davies (*Field*, May 8, 1932) ran the water out of a small spring-fed pond in order to dig the mud out. In so doing he dug out, not an isolated frog, but dozens. "Their appearance was not attractive—discoloured and skinny—but all alive, though showing very little energy."

Although the older naturalists believed in the hibernation of frogs in winter in the mud of ponds, doubt has recently been thrown upon the possibility of survival of air-breathing, lung-possessed creatures in such circumstances. However, in the height of the mating season, when activity is not at its lowest, one has seen beneath the clear water of a pond mated frogs remain for long periods inactive on the bottom, and in face of such experiences as are related above it seems probable that in cold weather the lowering of activity in these cold-blooded animals reduces metabolism to so low a pitch that the oxygen required can be obtained by transpiration through the skin. The problem still to be solved in regard to cold-blooded hibernators, as P. A. Gorer has pointed out, lies in the physiological changes which enable the tissues of an adapted animal such as the common frog (*Rana temporaria*) to recover from cooling which is not excessive, while such recovery is impossible in unadapted animals.

Societies and Academies

LONDON

Royal Meteorological Society, Dec. 14. C. S. DURST: "The thermal balance of a water drop or ice particle suspended in the atmosphere." From the examination of the long wave radiation received and given out by a water drop or ice particle, it is shown that such a particle will lose heat if it is above a certain critical temperature and gain heat if it is below, from which it follows that if a particle exists in the stratosphere it will gain heat. It is assumed that the base of the stratosphere is saturated and consideration is given to the conditions under which particles could be formed. If a small air mass were raised in the stratosphere the particles formed in it would be melted in a very short time and the temperature of the air would once more be that of its surroundings, the entropy of the air having been increased in the process.—E. W. BLISS: The tabulation of world weather (5). (Discussion by Sir Gilbert Walker.) (*Mem. Roy. Meteor. Soc.*, 4, No. 36.) In order to form more definite ideas regarding the oscillations named the North Atlantic, the North Pacific, and the Southern, series of figures have been derived to express the variations of each, and from these have been obtained their relations with pressure, temperature, and rainfall over wide regions as well as the relations of the three oscillations with each other and with sunspots. The southern oscillation in the southern winter is extremely persistent, and its departure has a correlation coefficient of 0·84 with that of the following summer.—C. S. DURST: "The breakdown of steep wind gradients in inversions." On certain occasions when inversions have formed, a violent eddying arises, which is shown on an anemometer as an abrupt change in the type of trace. This change over occurs when the wind gradient becomes great. On the ground that the eddies formed in these circumstances are different in character from those formed with an adiabatic temperature gradient, a suggestion is put forward for the mechanism of the diurnal variation of wind.

DUBLIN

Royal Dublin Society, Nov. 22. J. H. J. POOLE: An investigation of the behaviour of neon discharge tubes in a flashing capacity circuit by means of a cathode ray oscillograph. The effects of leakage currents in the oscillograph were eliminated by using the oscillograph in conjunction with a valve anode resistance amplifier. For small shunting capacities the flashing may be extremely irregular, and quite considerable currents pass through the tube before the flash occurs. The presence of radium lowers the striking potential and, by decreasing the maximum dark current, increases the regularity of flashing. The effect of the shape of the electrodes has also been investigated. For concentric cylindrical electrodes, at the filling pressures used, the difference between the striking and extinction voltages is less when the inner cylinder is negative. H. M. FITZPATRICK: The trees of Ireland, native and introduced. A catalogue of the tree species growing in Ireland giving the dimensions attained by each in different parts of the country with, in the case of exotics, an account of their natural distribution and introduction into cultivation. 150 broad-leaved and 215 coniferous trees are recorded. G. T. PYNE and J. J. RYAN: The colloidal calcium phosphate of milk. Some samples of milk out of a large number tested developed a marked alkalinity to phenolphthalein on addition of oxalate. As the wheys prepared from the same milks did not do so, it appeared that the alkalinity must arise from the interaction of the (potassium) oxalate with the casein calcium phosphate complex of milk, presumably owing to the conversion of insoluble tri-calcium phosphate into the strongly alkaline tri-basic potassium salt. The amounts of tricalcic phosphate required to account for the observed alkalinities approximated to those usually accepted for the entire colloidal phosphate of milk, suggesting that the greater part of this colloid must consist of the tribasic salt. The bulk of the casein calcium phosphate complex was removed by prolonged high speed centrifuging from two very different types of milk (as regards their reaction with oxalate) and submitted to analysis. The results appeared to show that the bulk of the colloid in each case consisted of tricalcium phosphate, and that the variations in the behaviour of different samples to oxalate was thus connected with the relative quantity of the colloid present rather than with variations in its composition.

PARIS

Academy of Sciences: Nov. 14. CH. MAURAIN and J. DEVAUX: Electrical conductivity and atmospheric condensation nuclei during a voyage to Greenland. There is a general resemblance between the electrical conductivity of the air in the polar regions and that on mountains at high altitude, possibly due to the purity of the atmosphere and the dryness. The measurements were too few to enable any deductions to be drawn as to the effects of the meteorological conditions. MARIN MOLLIARD: Aseptic tuberisation and morphological characters resulting from the action of saccharine food on the onion, *Allium cepa*. E. MATHIAS: Death by the return stroke (lightning). J. CANTACUZÈNE and A. TCHEKIRIAN: The presence of vanadium in certain tunicates. Vanadium has been found in nine species of tunicates: the proportion is higher in young animals than in adults. POTRON: The Riemann spaces admitting a group of isometric transformations with $n\ (n+1)/2$ parameters. MARCEL BRELOT: The study of the point singularities of subharmonic functions. PIERRE HUMBERT: Bessel-integral functions. D. POMPEIU: A theorem, analogous with that of Rouché, relative to the zeros of holomorph functions. NICOLAS APRAXINE: A calculating machine worked electrically. B. GALERKIN:

The general solution of the problem of elastic equilibrium of a hollow circular cylinder and of a part of the cylinder. R. de Fleury, H. Portier and S. Benmakrouha : The comparative and reciprocal influences of individual values, for each alloy and for each state of the alloy, of the modulus of elasticity, the elastic limit and the density on the dimensions of beams and elements of framework under bending. Louis de Broglie : The electromagnetic field of the light wave. L. Goldstein : The quantum theory of the diffusion of electrons. André Marcelin and D. G. Dervichian : The direct measurement of superficial pressure of superficial solutions formed by soluble substances. P. Rouard : The reflecting power of metals in very thin plates. The reflecting power varies with the thickness of the film, passing through a minimum depending on the wave-length of the light. Ch. Bedel : The temperature coefficient of the electrical resistance of silicon and a thermoelectric phenomenon of unipolar substances. A. Sanfourche and B. Focet : The calcium salt of a complex ferrophosphoric acid. F. Gallais : Potassium iodomercurate. Léon Jacqué : The alteration of steels by hydrogen. The modification of the micrographic structure of steel submitted to the action of hydrogen under pressure and at temperatures between 400° and 700° C., appears to be the result of two simultaneous phenomena : the elimination of the carbon of the steel by the hydrogen, and a diffusion of the carbon from the unaltered regions towards the decarbonised regions. The process is a reversed cementation. The change depends on the composition of the steel, chrome-nickel steels, for example, being less altered under the same conditions. M. Lesbre : An imperfect silver-guanidine complex. R. Levaillant : The action of acid chlorides on orthoformic esters. The preparation of symmetrical esters of sulphuric acid. The reaction $CCl_3.COCl + HC(OC_2H_5)_3 = CCl_3.CO_2C_2H_5 + C_2H_5Cl + HCO_2C_2H_5$ gives a 90 per cent yield of the ethyl trichloracetate. The reaction is a general one, and can be extended to the sulphonchlorides. G. Darzens : A new method of glycidic synthesis of aldehydes. Lespieau and Wiemann : The synthesis of allodulcite. Y. Milon : The antiquity of the depression of the gulf of Morbihan. G. Dubar and H. Termier : The facies of the Lias underlying the Toarcian in the Moroccan middle Atlas. J. Gauzit : An attempt at the estimation of atmospheric ozone by visual photometry. The method detailed, which has the advantage over other methods in use of taking less time, measures the thickness of the ozone layer in the atmosphere with an uncertainty of less than ten per cent. Ph. Joyet-Lavergne : Oxidising power, chondriome and cytoplasmic sexualisation in the Fungi. J. Beauverie and Mlle. S. Monchal : The life of green plants in a confined atmosphere. Plants contained in glass vessels, with moist earth, and sealed with paraffin wax, can live and grow for several years. Examples are given of plants which have remained in good condition for three or four years thus sealed up. Michel Gračanin : Contribution to the study of the relation between transpiration and the resorption of ions. Marc Simonet : New interspecific hybrids in *Iris* and their cytological study. Armand Dehorne : New observations on the asexual multiplication of an annelid of the genus *Dodecaceria*. Etienne Rabaud and L. Verrier : The evacuation of the gases from the air bladder and the working of the pneumatic canal. Paul Wintrebert : The two phases of segmentation and the subdivision theory in amphibians.

Forthcoming Events

Monday, Jan. 9

Royal Geographical Society, at 8.30.—B. Roberts : "The Cambridge Expedition to Vatna-Jökull, 1932".

Tuesday, Jan. 10

Royal Anthropological Institute, at 8.30.—Dr. N. Gordon Munro : "The Ainu Bear Ceremony" (Film).

Thursday, Jan. 12

King's College, London, at 5.—Prof. R. J. S. McDowall : "The Integration of the Circulation" (succeeding lectures on Jan. 19, 26 and Feb. 2).

Official Publications Received

GREAT BRITAIN AND IRELAND

The H.E.A. Year Book : the Annual Publication of the Horticultural Education Association. Vol. 1, 1932. Pp. 92+xl. (Wye : South-Eastern Agricultural College.) 3*s*. 6*d*.

County Borough of Southport : Meteorological Department : The Fernley Observatory, Southport. Report, and Results of Observations for the Year 1931. By Joseph Baxendell. Pp. 31. (Southport.)

Brompton Hospital Reports : A Collection of Papers recently published from the Hospital. Vol. 1, 1932. Pp. iv+144. (London.) 2*s*. 6*d*.

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 8 : Recent Views bearing on the Problem of the Irish Flora and Fauna. By Dr. R. Lloyd Praeger. Pp. 125-145. (Dublin : Hodges, Figgis and Co. ; London : Williams and Norgate, Ltd.) 1*s*.

True Temperance Scientific Committee. Monograph No. 8 : In Chase of Truth of Alcohol. By Prof. Henry E. Armstrong. Pp. 32. (London : Donington House.) 1*s*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 30 : A Suggested Mode of Radiotherapy when Long-continued Feeble Gamma Radiation may be Desirable. By Dr. J. Joly. P. 469. (Dublin : Hodges, Figgis and Co. ; London : Williams and Norgate, Ltd.) 6*d*.

OTHER COUNTRIES

International Hydrographic Bureau. Report of the Proceedings of the Third International Hydrographic Conference held at Monaco, 12-23 April, 1932. Pp. 435. (Monte Carlo.) 2.50 dollars.

Colony of Mauritius. Annual Report on the Royal Alfred Observatory for the Year 1930. Pp. 4. (Mauritius.)

Miscellaneous Publications of the Royal Alfred Observatory. No. 11 : Pilot Balloon Observations at Mauritius. By R. A. Watson and N. R. McCurdy. Pp. 17+3 plates. No. 12 : The Cyclone Season 1929–1930 at Mauritius. By R. A. Watson and N. R. McCurdy. Pp. 3+43 plates. (Mauritius.)

Indian Central Cotton Committee : Technological Laboratory. Technological Bulletin, Series A, No. 22 : Technological Report on Banilla Cotton, 1930-32. By Dr. Nazir Ahmad. Pp. ii+17. (Bombay : *Times of India* Press.) 8 annas.

The Quarterly Journal of the Geological, Mining and Metallurgical Society of India. Vol. 4, No. 1, August. Pp. 27. (Calcutta.) 6 rupees.

Paleontologiese Navorsing van die Nasionale Museum. Deel 2, Stuk 5 : *Voorlopige Beskrywing van Vrystaatse Soogdiere*. By Dr. Ir. E. C. N. Van Hoepen. Pp. 63–66. (Bloemfontein.)

Publications of the Observatory of the University of Michigan. Vol. 5, No. 2 : The Orbit of Comet Peltier-Whipple, Second Paper. By Allan D. Maxwell. Pp. 4. (Ann Arbor, Mich.)

U.S. Department of the Interior : Geological Survey. Professional Paper 166 : Physiography and Quaternary Geology of the San Juan Mountains, Colorado. By Wallace W. Atwood and Kirtley F. Mather. Pp. vi+176+34 plates. Professional Paper 167 : Lower Triassic Ammonoids of North America. By James Perrin Smith. Pp. v+199+81 plates. 70 cents. Professional Paper 171 : Geology and Ore Deposits of the Pioche District, Nevada. By Lewis G. Westgate and Adolph Knopf. Pp. viii+79+8 plates. 85 cents. Professional Paper 173 : Geology and Ore Deposits of the Stockton and Fairfield Quadrangles, Utah. By James Gilluly. Pp. vi+171+32 plates. (Washington, D.C. : Government Printing Office.)

CATALOGUES, ETC.

The Protexray Tube. Pp. 32. (London : Cuthbert Andrews.)

F/2 Spectrograph. (Lispec 33.) Pp. 4. Vacuum Thermocouples for Measuring Weak Alternating Currents. (Brug 31.) Pp. 2. (Delft : P. J. Kipp en Zonen.)

Calendar for 1933. (London : The *Chemical Trade Journal*.)

John G. Stein and Co., Ltd. Diary for 1933. Pp. 64+Diary. (Bonnybridge.)

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Gold in Kenya and Native Reserves

AS has happened on more than one occasion in the past, proposals gravely affecting the future of the native population of a British dependency have almost reached the point of being given effect before they have attracted public attention. In order that the gold recently discovered in Kenya may be worked, any land in the occupation of natives required for the leasing of mining rights is to be excluded from native reserves and the occupants dispossessed. To make this possible, amendments to the Native Lands Trust Ordinance have been drafted and embodied in a Bill which on December 21 passed its second reading in the Legislative Council of Kenya Colony.

When questioned in the House of Commons on December 20, the Secretary of State for the Colonies stated that the amendments had received his approval as an interim measure to facilitate the granting of leases and to remove any immediate difficulties which might retard the development of valuable minerals, property in which was vested in the Crown. Notwithstanding his assurance that he had satisfied himself that the interests of the natives would be fully safeguarded, it is impossible to receive this announcement without a feeling of unease. No information has as yet been made public to indicate the manner in which these safeguards will be made operative, in view of the conditions affecting native life in Kenya.

The amendments to the Native Lands Trust Ordinance, as they stand in the Bill, and as they have been explained by the Colonial Secretary in the House of Commons, will appear to the native as a breach of trust. They abrogate specific undertakings made on the part of the British Government. On their face they do not meet the needs of the situation which, inevitably, will arise.

What is the nature of these proposals? Briefly, they are that land may temporarily be excluded from a native reserve for the purpose of granting leases for the development of valuable minerals, and that in such cases compensation may be made by money payment, instead of being given in the form of land. The Colonial Secretary added that where compensation was given in the form of a money payment, it would be at least equal to what would have been given to a white settler; and the Chief Native Commissioner of Kenya stated that no native would be "a penny the worse" for the proposals.

In dealing with a white settler this attitude would be just, and the treatment meted out to him would, in all probability, be generous. In dealing with the natives the same treatment is neither just nor expedient. It deliberately sets aside the lessons which have been taught by scientific study of native institutions, of native modes of life and of native ways of thought.

The Native Lands Trust Ordinance is to the natives of Kenya their Magna Charta. It ensures to them their rights in their lands. It sets aside land as a native reserve; and it enacts that when, for the direct benefit of the native, land is taken from the native reserve, compensation shall be made by the addition of alternative land of an equal area. This is no mere concession to sentiment. It is a recognition that land is a vital factor in tribal life. At the same time, in setting aside tracts of land in exclusive native occupation, it provides a measure of protection for native institutions against the disintegrating impact of white civilisation.

The economic, social and religious life of an East African tribe or family group, speaking generally, is bound up with its land. Their only form of wealth is cattle, of which the importance is fundamental in the regulation of marriage and, indirectly, of all the social ramifications which issue therefrom, inheritance, status and the like. The group lives normally on the produce of its gardens and cultivated land. Land is a tribal possession, and its tenure by smaller groups determines relation to the chief, by whom it is allotted as the head of the tribe. Hence land is not only an essential for the subsistence of the tribe by pasture and tillage but also the basis of tribal solidarity. On the other hand, the spiritual relations and associations with the land are even more binding. It is the home of the ancestors, not of the dead, but of living spirits, and upon it grow the sacred trees at which the people from time immemorial have made offering to spirits, and of which the sanctity is such that damage to the least of their twigs may bring untold misfortune on the tribe.

Differences exist, naturally, from group to group; but as generally outlined, these are the factors, material and spiritual, with which any measure for dispossession will have to cope. It is improbable that any considerable number of the dispossessed natives will be settled on other land; and they can be given no security of tenure. This has been made plain. It has been said that they will not like being settled on land from which they can be ejected. It goes deeper than that. The tribes will have lost their sovereignty, to use the jurist's term. Their tribal status will have gone and they will see themselves, like other East African tribes settled on lands in the possession of others, sinking to serfdom.

On the other hand, those for whom no land is available, to whom a money payment—into a tribal fund—will be made, will receive a form of compensation they do not understand and for which they will have little or no legitimate use. They have no conception of either the employment or the value of money as an economic factor. The example of those who have gained experience of European currency by wage-earning proffers a warning. The money, usually, has been squandered and wasted, while its expenditure, by giving the individual an exaggerated idea of his importance, has loosened the bonds of tribal discipline and respect for chiefs and elders. As for the tribal fund, the experience of America, when the discovery of oil on a reserve has enriched an Indian tribe, has furnished an example of the difficulty of regulating expenditure to the tribal good. The money has been wasted and frittered away.

In introducing the amendments in the legislature on the occasion of the second reading of the Bill, the Chief Native Commissioner said that he feared that the amendments would be "unpopular" among the natives, and admitted that it would be necessary "to hurt their feelings, wound their susceptibilities, and in some cases violate their most cherished and sacred traditions by moving them from their land". Thus it is patent that the Administration has chosen this course of action, not through ignorance of facts, which anthropological science might have made available, but deliberately and with premeditation. It has elected to set aside the consideration of matters which are within the knowledge of, at least, the chief officer to whom the care of the natives has been entrusted and upon whom the responsibility of introducing and explaining the proposals has been laid.

It would seem a not improbable contingency, especially in view of the religious susceptibilities of the tribes, that the proposals, if carried into effect, will cause serious tribal unrest. The extent to which that unrest may spread is impossible to forecast, even if it is confined to the gold-bearing area, for this the authorities are at present unable to delimit. But quite apart from the possibility of tribal disturbance, the very serious problem arises of the future of the dispossessed natives, deprived as they will be of their only means of livelihood. Divorced from the land, tribal organisation and tribal discipline will disappear. Members of the tribe will become 'landless men', whose only recourse will be labour in the mines—had the Administration this in view as a possibility?—or to drift to the towns and European employment and, thoroughly detribalised, to add to the gravity of the problem, already grave, of the native rabble, saturated with vice, which threatens to become a menace to the European.

Much hangs on the decision to dispossess the native of his land. It is not a question that can be settled by a simple balancing of immediate gains and losses. The native cannot, like a white man, be compensated for disturbance by a money payment, however generous; and even if the exclusion of land were really to be temporary, in the sense that it lasted for a very brief duration of time—a matter that no one can judge at present—when once the native has been divorced from his land, the break-up of tribal institutions and the consequent detriment to morale are irrevocable. Among other tribes who remain undisturbed, confidence in the integrity and singleness of purpose of the Administration in dealing with native affairs will have been badly shaken.

Of those who have followed closely the trend in the development of the African in the years which have followed the War, a majority are convinced that for the safety of the European and the well-being of the African himself, progress must come through the gradual development of native institutions in harmony with native ways of thought; that safety lies in the support, the moulding and the building up of native ways of life and thought and not in violently breaking them down.

When, a few years ago, in Australia a large tract of land was set aside as a native reserve, the two States concerned concurred in forbidding prospecting for minerals on native lands. In Kenya an immediate and easily won prosperity may be dearly bought at the cost of an incalculable addition to the native problem and the weakening of the stock, physically and morally, from which the future population of the country will be drawn. Is it possible to reconcile the action now contemplated with the spirit, much less the letter, of the famous White Paper which enjoined that the interests of the native should be paramount?

Spectroscopic Analysis by X-Rays

Chemical Analysis by X-Rays and Its Applications. By Prof. Georg von Hevesy. (The George Fisher Baker Non-Resident Lectureship in Chemistry at Cornell University.) Pp. xi + 333 + 28 plates. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 3 dollars.

FOR a long time the line spectrum of an element has been used as a means for its identification and, more recently, spectroscopic methods have been developed not only for qualitative but also for quantitative chemical analysis. If the optical spectrum has been found so useful in the practical problems of analysis, it is only to be expected that the X-ray spectrum should prove capable of being similarly employed. When the nature and method of excitation of the optical and the X-ray spectrum are compared, it becomes clear that the latter has much to commend it. In the first place, the X-ray spectrum is much less complex and remains practically unaltered by changes in external conditions. Again, all the elements have similar spectra which differ from one another only in a regular and continuous decrease in the wave-lengths of corresponding lines as the atomic number increases. It is thus possible to predict with accuracy the X-ray spectrum of an element. Further, in order to excite the optical line spectrum, it is necessary to vaporise the material, while the X-ray lines can be obtained without the destruction of the material under investigation.

The important part which X-ray spectroscopy was destined to play in chemical analysis was foreshadowed by one of the deductions which Moseley made from his earliest measurements of X-ray wave-lengths. Even from the incomplete data at his disposal, he could and did deduce the number of elements between hydrogen and uranium which still remained to be discovered. Since then, several of these have been found and X-ray methods have played an important part in their discovery and identification.

Following on the pioneer work of Moseley, the comprehensive and highly accurate work of Siegbahn and his school has given us a very complete knowledge of the X-ray wave-lengths characteristic of the various elements. Apart from the fundamental importance of such measurements in connexion with the problems of atomic physics, they provide all the necessary data for the application of X-ray methods to the problems of chemical analysis. The importance of X-ray spectra in the solution of such problems is certainly more than sufficient to justify the publication of a book devoted to the subject and it would have been difficult to find anyone better qualified to write such an account than Prof. Hevesy, who has contributed so much to its development.

The earlier chapters are devoted to a discussion of the nature and production of X-ray spectra and contain an admirable account of the various ways in which such spectra may be excited and measured. This section, besides containing the description of all the necessary apparatus and methods, is full of information which will prove invaluable to the actual worker in this subject and is not readily accessible elsewhere. Naturally, for qualitative analysis, the method is exceedingly simple; the mere occurrence of lines corresponding to the characteristic wave-lengths of an element imply the existence of that element and a very rough quantitative analysis is obtained by a comparison of the intensities of the lines of the various elements. For many purposes, however, such an analysis is insufficient and accurate quantitative results are essential. It is in obtaining such results that the unsuspecting worker is liable to fail, unless he is aware of the many pitfalls and how these may be avoided by the use of a proper technique. These difficulties are discussed in detail by Prof. Hevesy and full accounts are given of methods which enable an accurate quantitative analysis to be made even when the element in question occurs only in very small quantities. The actual sensitivity of the method depends upon the nature of the material under investigation. In the analysis of minerals, it is possible to determine a concentration of about one part in 10,000, while in more favourable circumstances such as, for example, the determination of titanium in iron, a much higher sensitivity is obtained.

Of particular interest is Prof. Hevesy's description of analysis as carried out by the use of secondary X-radiation. Instead of mounting the material on the anticathode of the X-ray tube and analysing the radiation emitted by it as a result of electron bombardment, the material is mounted inside the tube in such a way that it is not bombarded by electrons but is subject to an intense X-radiation from a suitable anticathode. This method involves longer exposures but has the very great advantage that it avoids the heating up of the material and its possible change in constitution as a result of the evaporation of the more volatile constituents.

The remaining sections of the book deal with applications to special problems. As typical of these a full account is given of the discovery of hafnium and of its properties. This section is all the more interesting since it comes directly from one to whom the discovery was largely due. Incidentally, detailed accounts of the chemical properties and the optical spectrum of the element are included. The last section deals with the chemical constitution of the earth and contains a discussion of the relative abundance of the various elements in the earth and in the sun and stars. This may appear to be somewhat outside the natural scope of such a volume, but in actual fact X-rays have proved of considerable value in the determination of the relative abundance of the rarer elements in rocks and meteorites. Of special interest is the use of X-ray analysis to estimate the age of rocks by a determination of the uranium, thorium and lead content.

This is a book alike for the specialist and for the general reader. The specialist will find it full of instructive detail and most useful and comprehensive tables, and indispensable for reference purposes. The general reader will find a very readable account of one of the most interesting developments of the discovery of X-rays and much other information besides. The many excellent illustrations add considerably to its attractiveness.

Medical Biography

(1) *Osler and other Papers.* By Prof. W. S. Thayer. Pp. vi + 386. (Baltimore, Md.; The Johns Hopkins Press; London: Oxford University Press, 1931.) 21*s*. 6*d*.

(2) *The Genius of Louis Pasteur.* By Piers Compton. Pp. ix + 361 + 8 plates. (London: Alexander Ouseley, Ltd.; New York: The Macmillan Co., n.d.). 12*s*. 6*d*.

(3) *Ronald Ross: Discoverer and Creator.* By R. L. Mégroz. Pp. 282 + 4 plates. (London: George Allen and Unwin, Ltd., 1931.) 10*s*. 6*d*. net.

OF these three books, the first, which is written by a medical man, will appeal most to members of his profession, while the other two, which are the work of laymen, are more suited for the general reader.

(1) Dr. W. S. Thayer, formerly professor of medicine in the Johns Hopkins University and a former president of the American Medical Association, collected in a single volume a number of addresses and papers mainly of a biographical nature which he had delivered or published at intervals during his professional or university life. Five of them, which are devoted to the late Sir William Osler in his aspects as teacher, man and booklover, are undoubtedly the most interesting part of the book, in view of the close friendship that existed between Osler and the author for so many years.

The centenary of the publication of Laennec's classical work on auscultation which appeared in 1819 is celebrated by an address which Thayer delivered before the Canadian Medical Association at Quebec on June 26, 1919. After describing Laennec's contributions to medicine, Thayer deplored the present tendency in Canada and the United States to neglect clinical examination as taught by Laennec and Auenbrugger, the inventor of the method of percussion, in favour of laboratory reports.

Pasteur is commemorated by an address on his contributions to medicine and humanity which Thayer delivered at the Sorbonne on May 22, 1927, on the occasion of a meeting organised by the American Committee for the Commemoration of the Centenary of Pasteur's Birth.

Attention should also be directed to the address on the life and work of Richard Bright given at Guy's Hospital on July 8, 1927, on the occasion of the centenary of the publication of the first volume of Bright's medical cases which contains the description of the disease bearing his name.

The other biographical studies are connected with Reginald Heber Fitz of Boston, U.S.A., who in 1886 gave the first full account of the now familiar condition which he named appendicitis; John Howland of Baltimore, an eminent specialist in children's diseases; and Cotton Mather, the seventeenth century Congregationalist minister of Boston, elected F.R.S. in 1713, who among his unpublished manuscripts left a work entitled "The Angel of Bethesda: an Essay upon the Common Maladies of Mankind" as well as a small volume containing rules of health drawn up for the use of candidates for the ministry. Copious extracts from these two curious works are given.

The many friends and admirers of the late Dr. Thayer will be grateful for this collection of his writings, many of which would be otherwise inaccessible.

(2) In his work on Pasteur, whom he describes as "the scientist of the heart", Mr. Piers Compton gives a clear and sympathetic account of the life and achievements of this great Frenchman, relating in succession his studies in crystallography culminating in his discovery of the molecular dissymmetry of tartaric acid; his work on fermentation, and particularly his paper on lactic fermentation, which was the foundation of bacteriology; his overthrow of the doctrine of spontaneous generation; his preservation of the silkworm industry of France by discovery of the nature of the disease and its prevention; his studies in connexion with the French wine and beer industries; his development of the germ theory and particularly its application to surgery; and his work on anthrax and rabies.

Special emphasis is laid on the difficulties with which Pasteur had to contend, including not only illness in himself and his family but also the opposition which he first encountered from the medical faculty particularly in the Paris Academy of Medicine, of which he was elected a member, although he had never obtained a medical qualification or been through the ordinary medical curriculum.

(3) The biography of the late Sir Ronald Ross by Mr. R. L. Mégroz, who has dedicated his book to "all true hero worshippers", is divided into two parts, the first dealing with Ross's life and scientific achievements and the second with his literary work. Mr. Mégroz defends this division first by the claim that he is specially qualified to criticise literary work and secondly by the charge that Ross's literary work has been unduly neglected.

In addition to the account of Ross's life and work particularly in relation to the discovery of the transmission of the malarial organism by the mosquito, the first part contains a chapter in which the writer acknowledges his indebtedness to Mr. Walter Stott, formerly secretary of the Liverpool Mathematical Society, and Mr. J. T. Combridge, of King's College, London, for their exposition of Ross's work in mathematics and its application to epidemiology.

In the second part high praise is bestowed on Ross's work as a satirist, critic, dramatist, lyric, poet and novelist, numerous extracts being given from this comparatively unknown portion of his writings.

Appendices contain a bibliography of Ross's scientific and belletristic writings as well as lists of his honours and awards.

Fish and Fishing

(1) *The Flyfisher and the Trout's Point of View: New Light on Flyfishing Theory and Practice.* By Col. E. W. Harding. Pp. 208 + 11 plates. (London: Seeley, Service and Co. Ltd., 1931.) 21*s.* net.

(2) *Salmon Fishing.* By Eric Taverner. With Contributions by G. M. L. La Branche, Eric Parker, W. J. M. Menzies, J. A. Rennie, A. H. E. Wood, Wyndham Forbes, Thomas Rook and Alban Bacon. (The Lonsdale Library of Sports, Games and Pastimes, Vol. 10.) Pp. vi + 472 + 111 plates. (London: Seeley, Service and Co., Ltd., 1931.) 25*s.* net.

(3) *Salmon Hatching and Salmon Migrations: being the Buckland Lectures for 1930.* By W. L. Calderwood. Pp. 95 + 4 plates. (London: Edward Arnold and Co., 1931.) 4*s.* 6*d.* net.

(4) *Silver: the Life Story of an Atlantic Salmon.* By R. L. Haig-Brown. Pp. 96. (London: A. and C. Black, Ltd., 1931.) 3*s.* 6*d.* net.

(5) *The Life of the Sea Trout, especially in Scottish Waters: with Chapters on the Reading and Measuring of Scales.* By G. Herbert Nall. Pp. 335 + 94 plates. (London: Seeley, Service and Co., Ltd., 1930.) 21*s.* net.

(1) THE rules of fly-fishing are largely empirical and although the dry-fly purist is often no mean entomologist, the immediate aim of an angler is to present a fly to a fish as simply and as unobtrusively as he can; if he succeeds, he seldom worries about the fundamental principles involved, and is content to be frankly anthropomorphic in his outlook to the whole of the piscine world. Seldom, if ever, does an angler consider the point of view of the fish.

Some knowledge of the problems presented by under-water vision we owe to the fascinating work of Dr. Francis Ward. Col. Harding's book develops this theme and is primarily of interest to anglers. Avoiding all technicalities with commendable care, the author shows by a series of simple diagrams how the phenomena of refraction and total reflection influence the rays which reach the eye of the fish and there give an image which is quite unlike that which most anglers would imagine to be the case. The application of these principles is chiefly concerned with problems peculiar to fly-fishing, but they deserve the careful attention of all who are interested in life in surface waters.

Some of Col. Harding's conclusions will probably provoke criticism, for anglers are notoriously sceptical of innovation. From a scientific point of view, the main arguments are convincing although they raise extremely difficult problems. The reactions of a fish to its visual environment will not only depend upon the optical image which falls on the retina of the eye but also upon how far the fish's sensations from such an image are comparable to our own; the reduced and distorted image of an angler on the bank may induce a sensation much more acute than it would in the human brain. If an angler is to be a physicist and a physiologist, must he not also be a psychologist? The prospect may be a little terrifying but Col. Harding's book is an extremely stimulating contribution to literature and will give pleasure to all who are interested in fish or fishing.

(2) Mr. Taverner's book on salmon fishing forms a natural sequel to his previous volume (also in the Lonsdale series), which was devoted to the trout. The present work is worthy of its author and worthy of the series in which it appears. The author is an expert and a scholar, but he also knows how to impart his knowledge to those less skilful than himself. For this reason, Mr. Taverner's book can freely be recommended to all who can afford to have even a remote interest in salmon fishing.

The literature of angling is outrageously large and it is swelled by works which have, at best, a transitory value, but the present work is in quite a different category, for the author has taken the pains to impart his knowledge in such a way that experts and beginners can read his pages with both profit and pleasure. The book covers every aspect of salmon fishing and every stage of the salmon's life from the moment the egg is laid until the adult fish lies, like a bar of silver, at the angler's feet. Mr. Taverner has consulted fellow experts and with real ability he has expressed their wisdom in 450 pages every one of which gives a thrill of interest and has its value. The book is beautifully illustrated by half-tone figures and by numerous useful diagrams.

Both author and publishers are to be heartily congratulated on their work and a perusal of the ordinary edition makes one envious of those who can afford the edition *de luxe*. It is just a little unfortunate that such an admirable book should not have had a rather more attractive page, the margins of which are narrow while the type is none too clear—but such remarks border on captious criticism. It is a thoroughly good book.

(3) Dr. Calderwood's little book is a small but scholarly production. It gives in a condensed but readable form the conclusions to be drawn from the important work done recently in Canada and other places on the effect of stocking rivers with fry which have been reared artificially in hatcheries. The facts show fairly clearly that the rate of increase in the number of 'migrating' fish derived from a standard number of parent fish can be definitely increased by hatchery methods. In all cases, however, the percentage mortality of fry is extremely high ; hence, if hatcheries are to effect any serious increase in the stock of mature fish, they must be established on a very large scale.

Dr. Calderwood also gives an interesting account of what little is known of the migrations of salmon in the sea, and he provides an interesting map. At the end of the book, the author describes a record leap of a salmon at the falls on the River Orrin, in Ross-shire—a leap of eleven feet and four inches.

(4) "Silver" was an Atlantic salmon and the history of his life is told as a bed-time story for children. The author tells us that he has tried to make it interesting and at the same time tried to keep to the truth about salmon and their ways. Those who read this book will readily forgive any digression—if such there be—from strict and academic truth. The story is written in simple yet graceful language and the theme is worked out from beginning to end with real insight and outstanding ability. Those who feel that the teaching of Nature can impress upon a child's mind a healthy outlook on life and on death, will appreciate this book and will read the story of "Silver" and his mate with keen delight.

Mr. Haig-Brown has written a book which will rank highly as a permanent contribution to literature. It is to be hoped that it will receive the wide circulation which it undoubtedly deserves.

(5) Although the sea-trout is perhaps the most attractive of our migratory fish, its life-history is seldom familiar to anglers or to biologists. For many years Mr. Nall has devoted his attention to this fascinating and important problem, and the present book represents a summary of his work and an exposition of his views. It is, as the author says, an attempt to review his own work in perspective. The whole story is admittedly incomplete, but Mr. Nall has performed a real service to biology by putting into book form a series of data which are not only inaccessible to many ordinary people, but also form a solid foundation for future work.

The opening chapters deal with the technical problems inherent to all such investigations, and the critical analysis to which Mr. Nall subjects his own methods of observation inspires a confidence in his ability to interpret scales in terms of age and life-history. In Chap. vi an interesting contribution is made to the vexed problem of the systematic relationship between the sea-trout and the brown trout. Systematists usually deny any specific differentiation between the two forms, in view of the absence of all significant structural differences. To this view Mr. Nall gives qualified support, but he takes a wider—and a better view—of the essential criterion of a species. He is satisfied that there is a diversity of habit or physiological specificity to each type as striking as are the diversities of structure which satisfy the usual systematic requirements. These diversities of habit ensure that the two forms "keep apart on the spawning beds" and breed true. Behind him, Mr. Nall will find a solid body of opinion from those whose knowledge is based on their observations as anglers. That the two 'species' are closely related is obvious, and there can be little doubt that the migratory form is the more primitive of the two.

Among the perplexing problems offered by the sea-trout are those concerned with the factors responsible for the marked variation in the rate of growth and in the habits of fish taken in different localities. These factors are highly complex and only very extensive and reliable data will enable us to form an adequate estimate of the rôle which is played by each environmental factor. As yet, such data are clearly wanting and consequently the account given by Mr. Nall is of peculiar value. Unless the reader is very familiar with the remoter districts of the British Isles, this section of the book could be improved by the addition of a map. Apart from this slight omission, the book is well illustrated, and the half-tone illustrations are both beautiful and instructive.

Mr. Nall covers every aspect of the fish's life, and raises many interesting problems of scientific and economic importance. How far do sea-trout migrate away from coastal waters ? In many cases (for example, Beauly Firth fish), they apparently stay comparatively close to the shore, but, in other cases, journeys of two hundred miles do not appear to be uncommon. Problems of this type offer full scope for future work—and it is hoped that the publication of this book will help to provide an adequate solution. The author handles his data on growth and maturity in a rather depressingly orthodox manner, but the facts are there for all who care to analyse them differently. The whole book is a mine of information and it is a book for the specialist; at the same time it should be read by all anglers who know and appreciate the sea-trout.

In his introduction, Mr. Nall explains that he is not and never has been a member of the Fishery Board for Scotland; it is fortunate that at least one of the fishery boards of Great Britain has the ability to attract and to keep the voluntary services of an efficient and enthusiastic colleague.

Short Reviews

Education for Trades and Industries: a Historical Survey. By C. T. Millis. Pp. 164. (London: Edward Arnold and Co., 1932.) 6*s*. net.

MR. C. T. MILLIS has performed a service in bringing together in this little book much information relating to the early history of the development of technical training for apprentices and craftsmen in various trades and industries. Himself a pioneer in this sphere of work, he has been able to place on record much that might otherwise have been lost. Those technical educationists of a later generation, reading of the struggles of their predecessors to provide for industry a mentally and manually competent personnel, will not fail to realise the debt owing both by themselves and by industry to these earlier workers. Nor will they omit from their list of benefactors many of the individual City Livery Companies and the City and Guilds of London Institute.

Mr. Millis deals in separate chapters with some eighteen of the most important trades; and there is also a short chapter devoted to technical education for women. An account is given in each case of the first classes to be formed and of the development that has taken place up to the present day. Perhaps an undue prominence has been given to the names of those who were primarily concerned with metropolitan training schemes; for the remarkable extension of technical education in the industrial north has not been brought about without its own pioneers. Surely, for example, the name of the late Mr. J. H. Reynolds, one of the greatest and most far-seeing of all the early technical educationists, deserves more than a single passing reference, and that under the heading of photo-engraving and lithography.

The author has drawn largely and rightly upon his own personal experience: this, while adding to the interest of the book, has resulted in a picture with London high-lights and the provinces somewhat in the shade. A completely satisfactory history of education for the trades and industries of Great Britain has, indeed, yet to be written. Meanwhile, Mr. Millis's book should be read by all who are interested in the development of craft training.

The Form and Properties of Crystals: an Introduction to the Study of Minerals and the Use of the Petrological Microscope. By A. B. Dale. Pp. x + 186. (Cambridge: At the University Press, 1932.) 6*s*. net.

IN this small volume Miss Dale has endeavoured to provide the minimum amount of crystallography and optics necessary for students whose main interests are petrological. It is a difficult task at best, but on the assumption that traditional lines are to be followed, the general scheme may be commended. The author has evidently been at pains to write simply.

The chapter dealing with stereographic projections contains a number of straightforward examples worked through in detail, which should help in mastering what is to many a forbidding subject. Unfortunately, however, the book is somewhat marred by a number of mistakes. The treatment of refractive indices is not very satisfactory, and the reference in the text to the chart of birefringences inverts ordinates and abscissæ. Fig. 117 and its context provide a puzzle; the reviewer looked long and carefully at these without understanding anything at all. The customary phrase 'convergent polarised light' is not a happy one at the best of times, and although students will probably manage to obtain an interference figure by following the appropriate directions, they will be well advised to be wary of interpreting what they see in the light of this illustration.

F. I. G. R.

Methods in Plant Histology. By Prof. Charles J. Chamberlain. Fifth revised edition. Pp. xiv + 416. (Chicago: University of Chicago Press; London: Cambridge University Press, 1932). 18*s*. net.

THIS, the latest edition of Prof. Chamberlain's book, needs little introduction to workers in a botanical laboratory. The changes are many and important, amounting almost to a re-writing. The new chapter on "Illustrations for Publication" will prove helpful to many research workers and the mention of a section on "Movie Photomicrographs" will serve to indicate how the different editions march with the times. Directions for collecting, fixing, dehydrating and staining material have been improved and amplified and refinements of technique are detailed, which make it easy to obtain sections as thin as 2 or 3 microns, while thinner sections down to a thickness of 0·5 micron can be made. Prof. Chamberlain's hint as to the possible appearance of a microscope of such magnifying power that no section thicker than 1 μ is permissible, is rather intriguing and will demand further improvements in histological technique along these lines. The amplifications noted have involved no curtailment of the sections dealing with the collecting and growing of all types of laboratory material and with the application of the principles of fixing and staining in the study of each group of plants—these sections constitute the second part of the book as in the earlier editions.

N. F.

Caratteristiche dei sistemi differenziali e propagazione ondosa. Per Tullio Levi-Civita. Lezioni raccolte dal Dott. G. Lampariello. (Attualità Scientifiche, N. 41.) Pp. vii + 110. (Bologna: Nicola Zanichelli, 1931.) 15 lire.

THIS little book is founded on a course of lectures, given by the author at Rome in 1930–31, on the theory of characteristics of partial differential equations and their applications (following the methods originated by L'Hugoniot and developed by Hadamard) to wave motion in acoustics, elasticity, optics, electromagnetism and other branches of physics. It opens by recalling some existence theorems concerning partial differential equations. The characteristics are introduced as the loci of singular points where these theorems break down. We then pass on to the consideration of wave motion, and wave surfaces prove to be closely connected with characteristics. The most interesting part of the book is the concluding section, which deals with the wave-particle dualism of modern physics according to de Broglie. An account is given of the recent dynamical-optical work of Persico, which aims at making Schrödinger's wave equation plausible, and a tantalisingly brief reference is added concerning Racah's use (in 1931) of the principles expounded in this book to obtain a justification of Heisenberg's principle of indeterminacy. Most readers will probably wish for a fuller account of the new developments so briefly mentioned here.

H. T. H. P.

The Grey Squirrel: the Introduction and Spread of the American Grey Squirrel in the British Isles, its Habits, Food and Relations with the Native Fauna of the Country. By A. D. Middleton. Pp. viii + 107 + 8 plates. (London: Sidgwick and Jackson, Ltd., 1931.) 4*s*. 6*d*. net.

THE grey squirrel has become almost as valuable as the sea-serpent to correspondents of British newspapers, and genuine inquirers who are distraught between the assertions of the 'pro-squirrelites' and the 'anti-squirrelites' will be glad to have this authoritative work at hand. It touches upon the life of the grey squirrel in its native home in eastern and central North America, but its real purpose is to describe the invader in the land it has invaded with such success that from one centre (out of about thirty) it has spread over 1,350 square miles, and that, in thirty years. The food and habits, the much discussed relations with the native red squirrel and other animals, and the economic aspects of the pest are dealt with thoroughly, the conclusion being reached that three main counts have been proved against it—damage to forests by peeling bark and destroying shoots, destruction of agricultural and garden produce, including fruit, and destruction of birds' eggs and young. Suggestions are made for the destruction of grey squirrels, but the seriousness of the menace in the British Isles has not yet been realised.

The Background of International Relations: Our World Horizons, National and International. By Prof. C. Hodges. Pp. xvi + 743. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 21*s*. net.

AN excellent compendium of world politics viewed from a common-sense angle, this book illustrates the point that international politics should be everybody's business. The basic principles of politics are the refined result of the crowding of the globe and the struggle for elbow-room and racial survival. So business has become the driving force in politics; and economic hunger drives nations to seek commercial supremacy backed by the power of the State. Yet enlightened self-interest forces these nations into world co-operation through political or non-political means. Yesterday's isolation of nations has gone: statesmanship has now to deal with news-minded nations. The author believes that knowledge alone can control the destiny of peoples, and that world-forces do not yield to emotions. There is much to be said for his final statement that peace is a state of mind, and not a political institution. A wealth of references and a good index are features which add to the practical value of this work.

T. G.

The Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland: with a Record of Publications issued during Session 1931–1932. Compiled from Official Sources. Forty-ninth Annual Issue. Pp. vii + 167. (London: Charles Griffin and Co., Ltd., 1932.) 10*s*. net.

THIS annual, which has now reached its forty-ninth year, supplies valuable information concerning learned societies of Great Britain and Ireland, including officers, conditions of membership, meetings, publications, etc., and also gives particulars of various government scientific institutions. The new form of the publication initiated last year, which involved omitting lists of papers read before societies, has been continued this year. Many societies have been added, thus adding to the value of the volume as a work of reference.

Volcanic Craters in the Libyan Desert

By Dr. K. S. Sandford

IN the last few weeks, reports of the occurrence of volcanic craters in the Libyan desert have appeared in the daily Press. It seems wise, therefore, to define the discoveries more precisely as soon as possible, although detailed study of the material collected must be postponed for several weeks.

In the spring of 1932, the late Sir Robert Clayton East Clayton and Squadron-Leader Penderel, R.A.F., observed and photographed some crater-like hills between the Gilf Kebir and Gebel 'Uweinat, near the southern end of the Egyptian-Cyrenaican frontier. Sir Robert also flew over them with Mr. P. A. Clayton, of the Desert Survey of Egypt, who, with Count De Almàsy, was a member of the expedition. Some of their photographs appeared afterwards in the *Illustrated London News*, and Mr. Clayton has sent a paper on the western side of the Gilf Kebir to the *Geographical Journal*. The party was unable to visit the craters but their approximate position was computed.

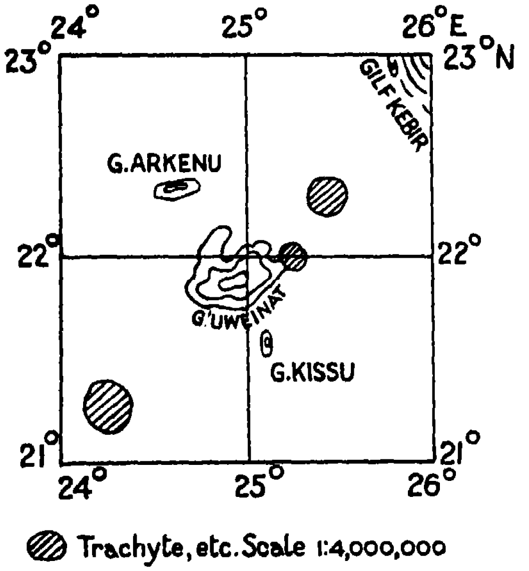

FIG. 1.

In the first week of October 1932, Capt. Craig, R.E., W. B. K. Shaw, G. L. Prendergast and I set out in a car from Gebel Kissu, the advanced base of the recent expedition led by Major R. A. Bagnold, and found the craters on the same day. Those previously seen from the air proved to be explosion craters; others, less obvious, were found to be the denuded stumps of volcanoes: both types were encircled by high ramparts of steeply tilted, hardened, and locally fused Nubian sandstone. Seven principal hills, standing 100–300 ft. above the plain, are grouped within a radius of about five miles, and to these must be added minor elevations and a thick horizontal sheet of 'lava' which caps a prominent hill nearby; this may have been a surface flow or a sill.

One of the best preserved of the explosion craters was about half a mile wide from east to west and about a quarter of a mile wide from north to south (inside measurements), with vertical walls of hardened Nubian sandstone rising 100–130 ft. above the plain. The centre, partly filled with sand and rubble, was at about the same level as the plain, and water flowing from it has cut a deep channel through the southern wall. Some of the craters evidently now contain lakes after the rare rains, and the remains of mountain sheep and other animals that came to them were common.

Within the main ramparts of at least two of the explosion craters were found subsidiary plugs of white trachytic rock, and adjacent to them the fusion of the sandstone walls was very marked. The relative ages of explosion and flow of molten rock in these multiple craters seemed to vary. Into the white rock had been intruded a dark basalt-like rock of much the same specific gravity as the trachyte: although both rocks varied appreciably in texture over the area, their mutual relation seemed to remain the same.

A noticeable feature of the whole neighbourhood was the presence of double walls of hardened sandstone, running on straight or curved courses over the surrounding plain and across some of the craters. These, and pipe-like tubes of irony sinter penetrating the unbroken Nubian sandstone of the plain, seem to have been formed by hot solutions at a late stage of the period of activity. In some, amorphous and gypseous substances occupied the space (usually four to six feet) between the parallel faces of the double walls.

During our reconnaissance from the craters to Gebel 'Uweinat, we found a similar but smaller area at the north-eastern corner of the massif. Here, in particular, prismatic sandstone, well-known to Messrs. H. J. L. Beadnell and P. A. Clayton from their surveys in adjacent areas, was intimately associated with the type of 'wall' already described.

At about this time, Squadron-Leader Penderel, who had followed our party out from the Nile valley by air, landed beside us and was kind enough to take specimens for me to Cairo, where they were given to Mr. O. H. Little, director of the Geological Survey of Egypt. I am indebted to Mr. Little for some notes which reached me on our arrival in Fasher several weeks later.

A considerable 'volcanic field' may, therefore, now be added to the map between the north-eastern corner of 'Uweinat and about lat. 22° 18′ N., long. 25° 30′ E. A similar volcanic area, with trachytic rocks, was encountered on the south-western side of 'Uweinat during the investigation of the country westward to Sarra and the Tibesti foothills. It is centred about lat. 21° 16′ N., long. 24° 14′ E., with a radius of about six miles, and most of its denuded stumps were visited by Lieut. D. R. Paterson and myself. There seem to be no explosion craters in this group.

Each 'field' is associated with very slight folds of the Nubian sandstone, and the complex of ancient rocks upon which it lies is exposed in the immediate vicinity by the denudation of the slight surviving thickness of sandstone. The period of volcanicity is obviously far younger than the Nubian series, and the fresh appearance of the explosion craters suggests a fairly recent date of formation.

The discovery of a few stone implements of Middle Palæolithic type in and near some of the craters necessitates a readjustment of ideas, which is confirmed by comparison with the great crater of Malha, in the Meidob Hills about 150 miles north-north-east of Fasher. Malha seems to have exploded but yesterday: the basaltic lavas which surround it and have flowed into one corner of it are fresher than many on the flanks of Vesuvius, yet the traditions among the people who depend on the springs within it seem to recall only variations of level of the lake in its centre. These explosion craters seem to be far older than they at first appear.

The presence of light trachytic rocks within a radius of about 50 miles from Gebel 'Uweinat is of interest in contrast to the wide distribution of basalt and dolerite over Egypt and the Sudan, ranging from an Oligocene age in Egypt to at least a semi-recent age at Malha. About 'Uweinat the dolerites seems to be of far greater age than the features described above, but there was a later effusion of basaltic magma at Malha—the presence of basaltic lava and of 'volcanoes' in the Bayuda desert between Berber and Merowe (Dongola) will be recalled—probably long after the trachytes of 'Uweinat were cold.

The Old Morphology and the New*

By DR. H. HAMSHAW THOMAS

"THE full problem of morphology is . . . to explain how in the past plants came to be such as we now see them" (Bower). The problem is often regarded as insoluble, but a survey of the development of morphological concepts suggests that some of our difficulties may be due to the tacit acceptance of theories handed down by successive generations of teachers. In dealing with the flowering plants, almost all recent writers accept the classical concepts originated by Goethe and Lindley in pre-evolutionary days. During the last thirty years, however, a large body of facts has been accumulated about the simpler and older plants, and a new system of ideas has been founded, which is in harmony with our knowledge of the form of the earliest known Devonian land plants. We have now to face the question of the relation between the fundamental concepts of the old morphology and those of the new.

At the outset of any discussion of form, it is necessary to keep in mind the principles underlying our comparisons. In the past, before the coming of evolution, comparisons of plants were mainly subjective, but to-day we aim at an objective approach. Plants are objectively comparable because we consider them to be derived from common ancestors; if we reject the subjective approach, we must introduce phylogenetic considerations.

We owe the term 'morphology' and the foundation of the classical concepts to the poet philosopher, Goethe, who published in 1790 a treatise "On the Metamorphosis of Plants", which has been called "the foundation of all that has since been done in vegetable morphology". The most important conclusion in this essay is that "whether a plant produces leaf-buds, flowers, or fruits it is still the same organ which is carrying Nature's laws into effect, though performing different offices and disguised under different forms". This one organ is called the leaf, but Goethe appeared to feel that it should be given some more generalised designation.

The spread of this doctrine in England was largely due to Lindley, who repeated Goethe's views and arguments, but he made an important modification in the theory which has received insufficient attention. Goethe wisely wrote near the close of his essay, "The thing now to be aimed at is to keep habitually in view the two contrary directions in which variations are developed. For we may say with equal truth that a stamen is a diminished petal or that a petal is an expanded stamen."

Lindley, however, concludes that "the leaf, as the first formed, the most perfect of all [the appendages] and that which is most constantly present, is properly considered the type from which all the others are derivations". This unsupported assumption was widely accepted, and Darwin in "The Origin of Species" spoke of the view that the parts of the flower consist of metamorphosed leaves as familiar to almost everyone. As the result of Darwin's work, the old concepts of the subjective and idealistic philosophers have been taken over and given an objective significance by biologists.

The doctrine of metamorphosis led to the idea that the parts of plants could be divided into three distinct categories, stems, roots and leaves. This has met with less universal approval. It may be tenable when we are dealing only with the mostly highly evolved forms, but when an attempt is made to extend it downwards grave difficulties are encountered. It has resulted in an unnatural separation of the Thallophyta and Bryophyta from the higher forms.

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* From a paper read to the Linnean Society of London on November 10, 1932.

The major concepts of the classical views have in the course of time come to be considered as so axiomatic that few writers have troubled about the evidence on which they were based, or have followed up their implications. But modern work has cast doubt on most of the arguments used in founding the system. Grégoire has found that the primordia of the stamens and carpels at their first appearance can be distinguished from those of foliage leaves, and so is led to the view that the stamens and carpels are organs *sui generis.* The validity of arguments based on abnormal flowers was challenged some years ago by the late Prof. K. von Goebel, and more recently by Mrs. Arber on the principle of irreversibility in evolution. Thus the only uncontested evidence is that derived from comparisons during the progressive growth of the plant, which, as Goethe pointed out, may be read in two opposite ways.

It might be reasonably expected that the great outburst of morphological research which followed the rise of the doctrine of evolution would provide evidence in support of the fundamental concepts. But no fresh evidence has been obtained. The continental morphologists of the classical school reject all evidence derived from the study of comparative anatomy and vascular structure as worthless, and they likewise seem to reject considerations of ontogeny, cytology and evidence derived from fossil plants. It may be that anatomical and developmental studies are held to have no bearing on morphology because they are known to conflict with the classical concepts. Most English morphologists regard anatomical and palæobotanical work as valuable, but in attempting to apply new knowledge to old concepts find that more problems are raised than solved.

The general ideas of the new morphology which may be said to have originated twenty-four years ago with the work of Lignier, Tansley and Bower, are based on considerations of phylogeny. The forms of plants and plant organs can only be explained by reference to their origin, and even though we cannot trace back the development of a group of organisms, we may in various ways obtain glimpses of the types of change which have gone on in the past. Fragments of the evolutionary history of one group may enable us to guess what has probably gone on in another group. The classes pteridophytes, gymnosperms and angiosperms may well represent stages in evolution rather than independent groups of organisms, and there is much evidence pointing to parallel evolution in the various groups. When endeavouring to draw the broad generalisations on which a system of morphology is based, it is unnecessary to trace the complete phylogenetic history of all the groups of plants, unless we consider that the different groups have been derived from independent algal ancestors, and that all traces of the previous history of many of them have been obliterated.

Even the present incomplete state of our knowledge enables us to determine the general trend of evolution throughout the ages with some degree of probability, and it may well be that the geological record of plant life is more complete than has previously been supposed. Any general system of morphological ideas should be applicable to all plants, but only one group has yet been fully studied from the new point of view. Prof. Bower's work on the ferns provides us with evidence as to the probable evolution of this group drawn from a number of different aspects. Zimmermann, in a publication of a different character, has shown how well the new views can be applied to the gymnosperms.

From a study of the Pteridophyta and the earlier fossil plants we are led to suppose that the very early land-plants were simple structures of the *Rhynia* or *Psilophyton* type, in which there is little differentiation beyond that of the sporangia. Afterwards roots became specialised from underground branches, and in some groups small simple leaves appeared. The large leaves characteristic of most of the higher plants seem to have evolved from branch systems and long retained traces of this origin. The primitive terminal sporangia either retained their original position or became involved in frond formation and attained a marginal or superficial position ; they often formed tassel-like groups and frequently became more or less fused.

These generalisations are quite inconsistent with the classical ideas of morphological development, and call for a modification of our ideas of homologous structures. They suggest that the foliage leaves and reproductive organs of the flowering plants can only be regarded as homologous structures because they are both derived from branch systems. Stamens and carpels have never been typical leafy structures with an expanded lamina, and it is probably misleading to call them sporophylls.

These newer concepts help us to understand the gymnospermous reproductive organs. It is no longer necessary to assume that terminal ovules in *Ginkgo* and *Ephedra* were originally produced on lateral leafy organs which have disappeared without leaving the slightest trace of their former presence. There is a great gap between the Psilophytales and the flowering plants, but it is to some extent bridged by the upper Palæozoic pteridosperms. The derivation of the *Caltha* type of carpel from a *Caytonia*-like structure has already been suggested, and we can now link the Caytoniales more closely to the pteridosperms owing to the discovery in the Triassic rocks of South Africa of a new group of seed-bearing structures.

When we come to examine all the known pollen-bearing structures of the seed plants with large leaves, it seems as though we can distinguish a gradual progression along two or three distinct lines, commencing with terminal groups of separate sporangia produced in groups, and leading to Mesozoic structures which may either be like branched stamens, structures bearing bean-shaped synangia, groups of sporangia borne on the surface of a leaf-like structure, or organs resembling the male flowers of the poplar. Nothing is known of a fertile leaf like that envisaged in the classical morphology. The study of these forms, however, suggests that angiospermous flowers may have originated in more than one way.

When we examine the forms of expanded leaves throughout the past, it is impossible to avoid the conclusion that 'compound' leaves are of a more primitive type than 'simple' leaves. In certain cases, however (for example, the Date palm), a new type of compound leaf has probably arisen from a simple form.

In other branches of science the interpretation of observed facts is facilitated by making successive assumptions and by comparing the theoretical results of each with the observations already made. This procedure has not been followed in plant morphology. The old system provided one set of assumptions only, founded more than a century ago on a very imperfect knowledge of the plant world, and for many years endeavours have been made to harmonise our ever-increasing observations with these postulates, distorting or discarding all those facts which seemed inconsistent. While it is quite probable that the assumptions of the new morphology may prove to need drastic emendation, they may nevertheless serve a useful purpose in the study of plant evolution.

Obituary

MR. H. A. ROBERTS

MR. H. A. ROBERTS, secretary for thirty years of the Appointments Board of the University of Cambridge, died at Cambridge on December 18 at the age of sixty-eight years. After ten years as senior mathematical master at Bath College he returned to Cambridge as a coach in mathematics in 1898. But his life's real work began when he was appointed in 1902 to be secretary of the University Appointments Board. He was keen to develop a new line of openings for university graduates in business and administrative posts, in addition to the more obviously natural academic, professional and technical positions which most men then sought after graduation. By great care in the selection of the men whom he recommended to the firms which applied to the Board, he not only succeeded in overcoming a prejudice against university men in business but he also created a new demand for such men on the part of large industrial undertakings.

Thirty years of devoted service on Mr. Roberts's part brought their own reward in intimate and friendly relations with the heads of industry, with their younger successors who had gone into business under his auspices, and with generations of college tutors, with whom he always worked in the closest touch. Gonville and Caius College elected Mr. Roberts as a Fellow in 1927, his advice was sought in Government circles and in the formation of appointments boards at other universities and for the women's colleges at Cambridge. He retired on account of ill-health only last autumn. It is sad that he should have lived so short a time to enjoy his hard-won leisure, but it is something that he was able to attend, less than a fortnight before his death, a complimentary dinner at which a presentation was made to him on his retirement by a number of those whom he had served so well.

MR. A. R. WRIGHT

MR. A. R. WRIGHT, who died on December 24 at the age of seventy years, played an important part in organising the work of the examining staff of the Patent Office to its present high level of efficiency and was also a recognised authority on folk-lore.

Wright entered the Patent Office in 1885 and from that date until his retirement forty-two years later worked unremittingly to place the classification of patent specifications for search purposes on a sure foundation. He was the editor of the well-known official series of illustrated class abridgment volumes which were published at the rate of more than fifty volumes a year to cover, by the year 1905, all patent specifications issued up to that time from 1855. The classification scheme on which this mass of material was indexed and through which alone the official search for novelty introduced by the Patents Act of 1902 was made possible, was largely Wright's work, and its amplification in subsequent years to meet the ever-growing amount of search material in the examiners' files and the development of industries and industrial processes was carried out under his personal supervision with a thoroughness and care for detail which were characteristic of the man.

The Patent Office classification as it stands to-day, exceptional in many respects, deserves a high place among the several developed classifications of applied science, and is a worthy memorial to Wright's energy and capacity. He was appointed assistant-comptroller of the Patent Office in 1922, while still retaining the classification as his main charge, and retired from the service in 1927.

As a folklorist, Wright was known not so much for his literary output, which was not large, as for his encyclopædic knowledge of folk beliefs and customs, obtained by extensive reading and an unusually retentive memory, which was ever at the disposal of anyone seeking information, and for the valuable services he rendered through the Folk-Lore Society, of which he became a member in 1890. He was a prominent and active member of the Council of the Society from 1898 until his death, and president for the two years 1927 and 1928, while he was an invaluable editor of the Society's journal *Folk-Lore* from 1912 until 1931.

At the time of his death, Wright was engaged in editing for the Folk-Lore Society the English material which had been gathered together, mainly by his own labours, for a collection of British calendar customs which the Society had decided to publish. All folklorists will regret that his invaluable help and advice have been withdrawn at a time when they were most needed, but this should only be an added spur to see that the task to which he had given so much time and work is completed. Wright was a fellow of the Society of Antiquaries and of the Royal Anthropological Institute, and had many outside interests ranging from the collection of Utopias to the Shakespearian productions of the Old Vic Theatre, which he attended with unfailing regularity until his last illness.

MR. G. STEPHENSON

MR. GEORGE STEPHENSON, who died in Letchworth on December 29, in his seventieth year, was for many years the principal of the Albert Agricultural College, Glasnevin, and lecturer on agricultural chemistry in the Royal College of Science, Dublin. He was born in Yorkshire in 1863, and was educated for the teaching profession, but soon turned to the study of chemistry and physics in their applications to agriculture. He gained a national scholarship and went to the old Royal College of Science at South Kensington, where he studied under Sir Arthur Rücker, Sir Edward Thorpe and Sir Norman Lockyer. He was a student during the years 1887–1889, and was deeply impressed by the lectures and practical classes, and he retained his notes during his whole life. With Sir Norman Lockyer he carried out some spectrographic research, and he would show with pride the photographs he made at that time.

After leaving South Kensington Mr. Stephenson became science master at Cheadle Hulme School, and later joined the staff of the Agricultural Department of the University of Leeds, but shortly afterwards he accepted an invitation to join that of the Royal College of Science, Dublin, which had been reorganised by the Technical Department presided over by the late Sir Horace Plunkett.

A few years later whilst retaining his lectureship Mr. Stephenson was appointed principal of the Albert Agricultural College, which had been opened in the middle of the last century by the Prince Consort. Here he found the congenial work of teaching and training students, many of whom in every part of Ireland, in Great Britain and throughout the Empire have done most important and useful work for agriculture.

Mr. Stephenson, though a strict disciplinarian where order and method were concerned, was above all things a sympathetic teacher and was never so happy as when helping students, individually, when necessary, with their difficulties. Being a man of wide reading and culture his lectures often extended far beyond the usual curriculum. His students will remember him with love and gratitude, and will regret the passing of so kind and great a teacher. He leaves a number of devoted friends, who will regard his memory as one of their cherished possessions. S. S.

WE regret to announce the following deaths:

Sir John Ballinger, C.B.E., formerly librarian of the National Library of Wales, who did much work in connexion with the organisation of school and village libraries, on January 8, aged seventy-two years.

Mr. G. S. Kemp, who was the Marchese Marconi's first assistant in his first demonstrations of wireless telegraphy, on January 2, aged seventy-five years.

News and Views

British Association: New President Installed

ON January 6, the usual meetings of organising sectional committees of the British Association were held to decide the lines of the programme of the Leicester meeting next September. As under a new statute the annual office of president of the Association corresponds with the calendar year, occasion was taken to welcome Sir Frederick Gowland Hopkins to the chair. Sir Alfred Ewing, the retiring president, in introducing the new president, said that the Association has been fortunate in securing Sir Frederick Hopkins's services. Last year it had been, so to speak, the turn of that part of science which dealt with the constitution of non-living matter, and with purely mechanical processes, which can certainly kill, but cannot make alive. Now the Association turns, perhaps with relief and greater hope, to the still more difficult science of life—of the fascinating problems of which no one can speak with more authority and clearer discernment than Sir Frederick Hopkins. Sir Alfred stated that it seems not unlikely, and probably it is desirable, that in future meetings of the Association, scientific workers will make a more conscious effort to relate their studies to social problems. Science is now playing so large a part in human life, both for good and for evil, that scientific workers cannot logically stand aloof. Science has brought new powers and new dangers —grave dangers of which the community is scarcely yet aware. It is clearly the duty of science to point these out. After his installation, Sir Frederick Hopkins said that Sir Alfred can be well pleased with his tenure of office and with the delivery at York of an address which in many minds stimulated thought along desirable lines on the readjustment of science and civilisation. Sir Alfred is retiring from office in the full assurance that he has helped the Association greatly.

Miners' 'Claims' and Native Lands in Kenya

ELSEWHERE in this issue (p. 37), we have discussed the grave situation which may arise through the proposed legislation dealing with gold prospecting in native reserves in Kenya. The explanatory memorandum issued by the Chief Native Commissioner of Kenya Colony to the natives likely to be affected has now been published in the *Times* (Jan. 5). It would appear to be fundamentally opposed to the whole conception and purpose of the institution of a native reserve, and is likely to be thoroughly disturbing to the minds of natives nervous for their rights. It seems that no attempt will be made to segregate the native or to control the siting of mining claims. European interpenetration of native holdings on the reserve will be complete. The natives are informed that they may expect to see their holdings 'pegged', or such part of them as may be required, wherever it is thought worth while to look for gold, and their huts and shambas may be destroyed; while they are invited to squat on their neighbours' land and make money, pending the vacation of their own land at some indefinite date, by working in the mines. It is also suggested that natives may sell to the miner meat, chickens' eggs and vegetables, but this applies, presumably, to those who have not been dispossessed of their land. Sir Edward Grigg has rebuked the Archbishop of Canterbury for suggesting that "African interests . . . are likely to receive better and wiser consideration from 'public opinion' in this country than from the Government of the Colony"; but the anthropologist asks "*Quis custodiet ipsos custodes*"? This unfortunate memorandum, issued, be it marked, by the department responsible for the well-being of the native, passes over all that has been achieved by scientific study of native races and of the problems that arise from their unchecked contact with Europeans.

Liverpool School of Tropical Medicine

DR. J. MIDDLEMASS HUNT, who held the post of honorary dean of the Liverpool School of Tropical Medicine for many years, has, by the terms of his will, emphasised the great interest that he took in research on tropical diseases. He has made a bequest of £20,000 to the University of Liverpool in order to provide for the endowment of the chair of tropical diseases of Africa. This will greatly strengthen the position of the laboratory of the School in West Africa originally established under the will of the late Sir Alfred Jones. In the Sir Alfred Lewis Jones's bequest, a sum was set aside for the specific purpose of building a research laboratory in Sierra Leone, West Africa, but no endowment was available. The building was erected as soon as possible after the War, the first director of the laboratory and first holder of the chair of tropical diseases of Africa being Prof. D. B. Blacklock, who remained in charge from 1921 until 1929. The present director and holder of the chair is Prof. R. M. Gordon. The laboratory has a normal staff of three which, in exceptional times, has been increased to five, and combines research on West African diseases with pathological investigations of a routine nature connected with these diseases. Dr. Middlemass Hunt was impressed by the fact that this overseas development of the Liverpool School of Tropical Medicine lacks any endowment and his generous bequest is evidence of his desire to initiate the consolidation and extension of the work of this important branch of the School.

Institute of British Geographers

THE work, extending over the past two years, of various preliminary committees was brought to a conclusion on January 3 when the Institute of British Geographers held its first meeting and elected a council and officers. The initial membership is open to all present members of the staffs of university departments of geography in Britain; in the future, membership will be by election. With one possible exception, all universities, as well as a large number of colleges of university rank, in Great Britain have now departments of geography and there is thus an obvious need for co-ordinating the teaching and research work of their staffs and for permitting an exchange of views on matters of particular interest in the furtherance of the subject in the universities. The Institute is thus in no way a rival to existing bodies. In discussing problems of special interest to themselves, it is clearly not the desire of university geographers to lose the contact which they have with administrators, travellers and surveyors, amongst others, who provide so much of their material, through the Royal Geographical Society; or with the teachers who have charge of the school training of the rising generation, through the Geographical Association. At the first meeting, papers were read, on "Soils", by Mr. A. Stevens (Glasgow), on the geography of the Arab Empire in Europe, by Mr. W. G. East (London), and on a comparison between the iron industries of Northamptonshire and Lorraine, by Mr. S. H. Beaver (London). The council and officers elected are: *President:* Prof. C. B. Fawcett (University College, London); *Hon. Secretary and Treasurer:* Mr. A. A. Miller (Reading); *Hon. Assistant Secretary:* Dr. H. A. Matthews (Birkbeck College, London); *Council:* Mr. J. N. L. Baker (Oxford); Dr. R. O. Buchanan (University College, London); Prof. H. J. Fleure (Manchester); Prof. Ll. Rodwell Jones (London School of Economics); Prof. P. M. Roxby (Liverpool) and Dr. S. W. Wooldridge (King's College, London).

Centenary of Friedrich Koenig, 1774-1833

FEW things have assisted the spread of knowledge more than the invention of printing from moveable types, the mass production of paper and the introduction of the power-driven printing machine, the last of which we owe to the German printer Friedrich Koenig, whose centenary occurs on January 17. He was born at Eisleben on April 17, 1774, and, after attending school, was apprenticed to a printer of Leipzig and then worked as a journeyman. His first improvements were made in connexion with the ordinary hand press. To further his projects he came to England in 1806, and it was soon after this that he met his countryman, Andreas Friedrich Bauer (1783–1860), who possessed the mechanical skill Koenig lacked. Four patents were taken out between 1810 and 1814 and from these came the power-driven flat bed printing machine in which the paper was pressed against the type by a cylindrical roller. Through John Walter (1776–1847), two of Koenig's machines were installed for printing the *Times*, and with the appearance of the issue of November 28, 1814, a new era in newspaper production began. Koenig's success, however, was but the prelude to a long struggle against difficulties. Returning to Germany with Bauer in 1817, he founded a works for the building of printing machines at Oberzell near Würzburg, only to find it next to impossible to obtain properly skilled artisans. Five years indeed passed before the partners completed their first German printing machine, and throughout his life Koenig met with little but adversity. He died at Oberzell at the age of fifty-eight years. The business was carried on by Bauer and relations, and afterwards gained a wide reputation. The speed of an early Koenig machine was about two thousand sheets an hour. Improvements by Cowper and Applegarth raised the speed to 5,000–10,000 sheets an hour, the Hoes of America then built machines doubling the capacity and to-day the rate of printing is some fifty times as fast as that in 1814.

Royal Academy Winter Exhibition

OF the Winter Exhibition of the Royal Academy, illustrating the works of members who have recently died, one of the oldest academicians remarked that in no country could be brought together such a fine collection of sound painting from the work of men recently with us. Apart from merit, there is also the pleasure of seeing again pictures notable in their day, some of enduring appeal, while others markedly exhibit the fashion of another age. Both as regards number and interest, Orpen's pictures should be mentioned first. From the student-study, the "Hamlet Play Scene", with its dull browns and reds, the transition can be traced to the clear coldness of the colours in his recent portraits, well on the way to be 'old masters'. One of the most striking, that of the late Sir William McCormick (No. 87), will delight many readers of NATURE. Mid-Victorian days are recalled by the work of the late president, when the fashion was for stained glass windows, flowing garments and red-gold hair. Time was when in every annual exhibition one or more of Harry Tuke's pictures of bathing boys appeared. Here we have a collection of them and find them still pleasing, while Wyllie's sea-pictures are full of life and colour. In contrast with these the Lambert pictures seem wanting in atmosphere, but that of the Red Girl (No. 251) and Round Mirror (No. 260) should be noticed.

PERHAPS too low in tone for modern taste are the pictures of La Thangue, in which French influence is prominent. Great variety is shown in the works of Greiffenhagen, some of it almost heraldic, but including several character studies (Nos. 304, 306 and 325). Of contrast between an earlier and a later style there is none more violent than is exhibited in the work of Sims, from a delicate and poetic touch portraying in delicate mother-of-pearl tints the "Light that never was on Sea or Land", to strange conceptions in harsh reds, yellows and blacks. Many examples of the well-known work of Ricketts as a book-designer will be found in a case in Room IX, while his paintings are hung in the same room against a rose background. Great restraint is shown in the water-colours of David Muirhead, but more freedom is exhibited in his oil-paintings (543, 547).

Education for Industrial Management

OVER the signatures of Lord Rutherford, Sir William Bragg, Sir Josiah Stamp, Lord Eustace Percy, Lord Amulree, Sir Herbert Austin, Prof. C. E. Inglis, Sir Francis Goodenough and others, an important manifesto on "The Management Factor in Industry" was issued on December 31. The manifesto was drafted by a small committee all the members of which are voluntary workers in one or more societies or institutions dealing with functional phases of management. Of this committee, Mr. E. S. Byng was chairman and Mr. S. Townsend, honorary secretary. The manifesto emphasises the urgent need for a full appreciation of the national importance of the management function and of the rapid diffusion of management knowledge, and directs particular attention to the quality of industrial management. Systematic education for management is asserted to be one of the chief steps required to assure Britain's industrial future, and neglect of this factor is frequently responsible for our managers' failure to interpret the progress of science in terms of their own undertakings. The manifesto directs attention to the development of a science of management and points out that to an increasing degree men of high personal character and cultured vision are finding in management a sphere of high social service. They are using the resources and methods of science to raise the effectiveness of their contribution to the organisation and direction of industry.

WHILE on this side the application of scientific methods to the functions and processes of business organisation promotes greater efficiency, establishes standards, and replaces haphazard effort by the deliberate pursuit of predetermined objectives, management is also an art involving co-operation and understanding of the human factor, so that acceptance of the scientific principles and loyal co-operation in the plans of the organisation may be secured from all its members. Skill in technique; knowledge of workshop practice; sympathy with the human factor; a receptive mind and an international outlook—these elements combine to produce a type of management which represents both in purpose and in method a second industrial revolution. Attention is directed to the assistance which statistical science can give in the higher control of industry, whether in budgetary matters, departmental co-operation and responsibility, planning of sales and production or costing methods, and it is pointed out that such developments incidentally justify the increased application of technical research in industry. The manifesto concludes with emphasising the need for consolidation in the management field. Asserting that nothing short of a revolution in the general attitude to the operation of industry is needed, it appeals for serious co-ordination of efforts in this field both in the study of management science and in the exposition of its results, so as to raise the standard of management everywhere in industry.

The Case for Alcohol

IN a monograph entitled "In Chase of Truth of Alcohol", issued by the True Temperance Scientific Committee (Donington House, Norfolk Street, London, W.C.2. 1*s*.), Prof. H. E. Armstrong gives a vigorous popular exposition, couched largely in parabolic and allusive language, of the origin, relationships and uses of alcohol. In the dedication he states his conviction that in our attitude towards alcohol "we should abolish Pecksniff as our leader and become sensible, like foreign nations". He points out that while vineyards are going out of cultivation and the mash tun is shrinking, the cider-press is advancing in favour : the apple is becoming the rival of John Barleycorn. Taking a broad view of the position, alcohol and opiates (narcotics) have been alternatives throughout history : at the present day "the drunkard no longer disfigures society, but the nuisance of tobacco is everywhere and inescapable". Prof. Armstrong pictures tobacco as a powerful depressant, both of eyesight and of intelligence. Further, while the excessive indulgence in tobacco has induced in this generation a loss of appreciation of good cooking, alcohol has the opposite effect.

THE problems of nutrition and alcohol are inseparable, states Prof. Armstrong. The case against the reasonable use of alcohol as a beverage rests largely upon unsound experiments ; when taken in moderation at meals, alcohol exerts a favourable effect upon digestion. Constant indulgence in large quantities of dilute alcohol leads to obesity, owing to the effect upon fat metabolism of the lower concentration within the cells, determined by the influx of alcohol. Since the Oriental dietary is near the margin of safety, the artificial ingestion of water induced by the use of alcohol would probably favour downgrade changes and so inhibit the repair of tissues. The proportion of alcohol oxidised in the body is small, but it has a definite metabolic fuel value. As a source of mechanical energy, alcohol is a serious rival to petrol. "To the chemist, alcohol is no mere drug . . . it is a wondrous material, a true elixir of life ; the abuse lavished upon it is rarely otherwise than the abuse of ignorance. The fault lies with those who misuse it—these must be set aside, not alcohol."

Early Publication in Anthropology

Two notes, pregnant with suggestion for the field archæologist engaged in palæolithic research, appear among the communications presented to the Institut français d'Anthropologie last session (*L'Anthropologie*, T. 42, Nos. 5–6, pp. 679–682). As they indicated lines of search in connexion with matters which, it is suggested, may hitherto have escaped the attention of excavators, it was important that their publication, in however brief a form, should have been as speedy as possible. In one note, the Abbé Breuil described a spear-point of bone of Mousterian age from the cave of Castillo (Santander). No object in bone of this type of Mousterian age was previously known, except an example found by Dr. H. Martin at La Quina in 1913. M. Breuil suggested a resemblance to the wooden spear found by Mr. Hazzledine Warren, associated with a Clactonian industry, at Clacton-on-Sea, and pointed out that such finds as this indicated that the Mousterians were in fact acquainted with the working and polishing of bone. This note was followed by a second, by Dr. Martin, in which he described the bone point of Mousterian age found at La Quina and also a point, or rather poignard, made from the canon bone of a horse, which had been found in 1905. Before the discovery of this latter, bone work by the Mousterians was not known. He suggested that the rarity of Mousterian bone work was due to the fact that the deposits, in which Mousterian remains were found, were not favourable to the preservation of objects of bone, or these were not recognised by excavators. In view of the importance of these announcements, it is most unfortunate that although they were presented to the Institut at a meeting held in February last year, the report has only just been published.

International Geological Congress

THE postponed sixteenth session of the International Geological Congress will be held in Washington this year on July 22–29. A long series of excursions has been organised for the period July 9–August 30, and it has fortunately been possible, through the generous assistance of the Geological Society of America, to offer the longer excursions at a considerable reduction below the actual cost. In selecting participants, where the number is to be limited, preference will be given to geologists whose special interests accord with the major objects of the excursion, and to geologists from foreign countries. Two important changes in the arrangements should be noted. The period covered by the excursions and the general sessions now falls entirely within the summer vacation of British and European universities. The resource topic originally chosen, "Petroleum Resources of the World", has now been dropped in favour of copper resources, and authoritative papers bearing on this subject are invited with the view of the publication of a special volume. Full particulars of the conditions of membership, topics for discussion, and itineraries and costs of excursions are given in the third circular, which can be obtained, together with application forms for membership, from the General Secretary, Sixteenth International Geological Congress, United States Geological Survey, Washington, D.C.

International Congress of Physical Chemistry

ON the occasion of its twenty-fifth anniversary, the French Society of Physical Chemistry is arranging an International Congress of Physical Chemistry to meet in Paris in the third week of October of this year. Foreign scientific societies have been invited to collaborate. In addition to the usual receptions, banquets, etc., a series of discussions are being organised, dealing with outstanding physico-chemical problems, such as electronic conduction in metals and its relation to electrochemical phenomena. Communications upon this and other questions have been invited from eminent men of science in France and in foreign countries. These will be discussed at the forthcoming conference and will be published afterwards by the Société de Chimie Physique. Further information concerning the Congress may be obtained from Dr. Ch. Marie, 9 rue de Bagneux, Paris, 9e.

Mercury Arc Rectifiers

IN the *Brown Boveri Review* for October a very impressive list is given of the mercury arc rectifiers for power transmission which the firm has shipped to overseas countries. We are glad therefore to learn that these important devices for converting alternating into direct current are now being made in Great Britain by several manufacturers. For shipping abroad it is necessary that apparatus be provided with spare parts. For rectifiers these spare parts are made of porcelain, iron and steel. They cost little and can easily be kept in good condition. Two alternating current stations can be connected by a direct current link connected through two rectifiers. One rectifier converts A.C. to D.C. and the other converts D.C. to A.C. This arrangement is economical when the voltage at which power is interchanged through the link is high. This has led to the development of high-tension rectifiers. Pressures up to 50,000 volts have already been attained. Vacuum rectifiers are independent of the frequency. Mercury arc rectifiers do not operate at frequencies higher than about three thousand but from the practical point of view this matters little. It is probable that rectifiers may be used in the future for converting A.C. into D.C. for transmission along overhead wires, as difficulties arise in transmitting A.C. along these wires at full loads. If long-distance electrification of railways is ever adopted in Great Britain they would be most useful, for whatever systems are adopted by various companies, power on any other system can be transmitted to them and converted.

Meteorology in Southern Rhodesia

THE most recent Meteorological Report of the Department of Agriculture of Southern Rhodesia covers the year ending June 30, 1931. Included with it as an appendix is the Hydrographic Report for the years ending September 30, 1928, 1929, 1930 and 1931—a summary of rainfall and run-off for certain catchment areas in Southern Rhodesia, occupying four pages. The Meteorological Report contains the usual general review of the year, particulars of the climatological stations—which are all in the charge of voluntary observers or observers attached to departments other than the Department of Agriculture—and numerous climatic tables, together with a few miscellaneous items, including a tentative essay in the preparation of seasonal forecasts of rainfall based on a number of factors, such as barometric pressure at Rio de Janeiro.

THE results obtained so far indicate a degree of success that would, if maintained, be of great economic importance in agriculture, but unless the correlation coefficient of $+0\cdot77$ proves to have been an under-estimation of the degree of dependence of Rhodesian rainfall on the various factors from which it is being calculated, such successes will occasionally in future years be replaced by failures or partial failures. These should not, however, be frequent enough to make the forecasts useless to those with an intelligent appreciation of the proportion of success to be expected from given values of the correlation coefficient. Southern Rhodesia is one of those regions where the success of farming operations is very dependent upon a monsoonal rainfall that may seem ideal when the average only is considered, but which is capricious as regards its occurrence in individual years, and is too apt to occur in torrential downpours that result in an excessive loss to the soil through run-off at the surface. When farmers must face the lean years of deficient rainfall at a time of agricultural depression, it is not surprising that many fail and abandon their farms. This is mentioned in the Report as one of the factors contributing to a net loss of 32 observing stations in the eighteen months ending December 31, 1931.

Marine Biology in Ceylon

DR. JOSEPH PEARSON, in his Administrative Report of the Marine Biologist for the Year 1931 (Part IV: Education Science and Art (G). Colombo: Government Record Office, 1932), states that the year's inspection of the Ceylon pearl banks has not brought to light any new spat falls and as there are no mature oysters in large quantities at present, there is no prospect of a pearl fishery for at least another four years. The dredgings in the Gulf of Mannar, however, showed small patches of young oysters on practically all the paars, which is a promising sign for repopulation of the banks, as the heavy spat falls of 1921–24 followed a similar scattering of young oysters in 1920. During the diver's inspection of the pearl banks, in one or two places dense masses of *Avicula* spat were found attached to the *Sargassum* weed. This is known as 'false spat' and used often to be taken for the spat of the pearl oyster. The report also contains notes on the window-pane oyster fishery, chank fisheries and local fishing industries. Plans for development are sketched out and it is hoped that a fishing vessel of a modern type will soon be available by the aid of which it is proposed to carry out detailed investigations and research necessary to determine the best methods to be adopted for the bettering of the fishing industry by the introduction of modern fishing craft and modern fishing appliances.

Clothes and House Moths

A USEFUL pamphlet entitled "Clothes Moths and House Moths", by Major E. E. Austen assisted by Mr. A. W. McKenny Hughes, has recently been published by the British Museum (Natural History) as No. 14 in the Economic Series. The need for an authoritative publication, dealing with wide-spread pests of this kind, has been felt for a long time and the present pamphlet provides essential information as to the insects themselves and the best methods of dealing with them. Simple preventive measures are discussed as well as remedial treatments of a more drastic character. The pamphlet is well illustrated and includes the most up-to-date information available, free use being made of the valuable work carried out on these insects in recent years in both Germany and the United States. Applications for the pamphlet (price *6d.*) made to the British Museum (Natural History), Cromwell Road, London, S.W.7, should be accompanied by a remittance, including postage (*1d.*).

Flood-lighting and Bird-life

SINCE late in the autumn of 1931 the great marble shaft of the Washington Monument in Washington has been flooded with strong light after dark, but it was only during the autumn just past that small birds began to be found dead at its base in the mornings (Science Service, Washington, D.C.). Several hundreds were picked up in a short time during the period of the southward migration, some merely stunned but others killed outright or so injured that they died. Flood-lighting on land gives rise to the same problem as lighthouses at sea, the birds in both cases being either attracted to the light or dazzled by the light so that they strike blindly against the structure. It seems unlikely that the destruction of the birds will result in the withdrawal of the flood-lights, for not only do they add to the beauty of the Monument, but they also serve as a guide and a warning to aeroplanes, which in approaching the commercial air-port just across the Potomac River were incommoded by the proximity of a pinnacle 555 ft. high.

Radium in Canada

In 1930 radium-bearing deposits of pitchblende rich in silver, were discovered at Labine Point in the Great Bear Lake area of the North West Territories of Canada. Since then, active prospecting has been carried on. The November issue of the *Canadian Mining Journal* contains an article by Mr. H. S. Spencer (of the Mines Branch), on the assays of samples of these ores. The analyses disclose two types of ore: (1) a pitchblende-quartz and (2) a pitchblende-carbonate mineralisation containing barytes and often rich in silver. Uranium-oxide contents ranged up to 60 per cent with averages of 43 per cent on bulk shipments. In view of the high cost of radium, the importance of these discoveries needs no emphasis. (See also NATURE, Dec. 17, p. 924.)

Announcements

THE Ostwald memorial lecture of the Chemical Society will be delivered by Prof. F. G. Donnan in the Chemistry Lecture Theatre at the University of Liverpool on January 27 at 6 P.M.

THE following appointment has been made by the Secretary of State for the Colonies to the Colonial Agricultural Service: Mr. G. C. Stevenson, to be assistant botanist, Central Cane-breeding Station, Barbados.

THE twenty-fourth Kelvin lecture of the Institution of Electrical Engineers will be delivered by Sir Frank Smith, secretary of the Department of Scientific and Industrial Research, on April 27 at 6 P.M. The title of the lecture will be: "The Travel of Wireless Waves".

IT is announced in *Science* of December 23 that in view of the death of Prof. Louis W. Austin in July, 1932, Prof. A. E. Kennelly has been elected to the presidency of the International Scientific Radio Union (Union Radio Scientifique Internationale) to succeed the late General Gustave A. Ferrié.

A COURSE of lectures on some aspects and problems of medical and industrial psychology will be given at the London School of Hygiene and Tropical Medicine on Mondays and Wednesdays during the present term. The lecturers will be Prof. M. Culpin, Mr. Eric Farmer, Prof. M. Greenwood, and Dr. May Smith. The first lecture, a historical introduction, will be given by Prof. Greenwood on January 16 at 2 P.M. The course is primarily intended for students taking the diploma in public health or the diploma in industrial psychology of the University of London.

M. ALBERT PORTEVIN, president of the Society of Civil Engineers of France, will give the next annual May Lecture of the Institute of Metals. M. Portevin has chosen as the title of his discourse, "Quenching and Tempering Phenomena in Alloys". The lecture will be delivered on May 10 at the Institution of Mechanical Engineers, Storey's Gate, Westminster, commencing at 8 p.m. Visitors are invited. Cards of admission are obtainable from the Secretary of the Institute of Metals. The Institute, which this year celebrates the twenty-fifth anniversary of its foundation, will hold its annual general meeting in London on March 8–9.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A part-time lecturer in botany at the Chiswick Polytechnic, Bath Road, Bedford Park, W.4—The Principal (Jan. 18). A lecturer in organic chemistry at Auckland University College, New Zealand—The Secretary of the Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1 (Jan. 28). A professor of electrical engineering at the Heriot-Watt College, Edinburgh—The Principal (March 24).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Gonad-Stimulating Hormones in Hypophysectomised Animals

EXPERIMENTS previously reported[1, 2, 5, 6] on the effect of gonad-stimulating hormones in hypophysectomised animals have yielded somewhat contradictory results, probably because the number of animals studied has never been large. One of us (H. S.) has recently hypophysectomised more than six hundred albino rats by a modification of the Smith technique, by means of which it has been possible to complete the operation within five minutes, with unusually low immediate mortality, and we wish to present here a preliminary report of our findings.

The testes of hypophysectomised male rats, whether immature or adult, undergo atrophy, with reduction both of germinal epithelium and of interstitial tissue; the epididymides, prostates, and seminal vesicles are also much reduced in size. Treatment with the anterior pituitary-like hormone of the human placenta ("A. P. L.")[3] does not prevent degeneration of the germinal epithelium, but the interstitial tissue displays marked over-development, and there is consequently no atrophy of the accessory sex organs.

Noguchi[4] says that, in the ovary of immature hypophysectomised rats under the influence of pregnancy urine or placental emulsions, the thecal cells proliferate, becoming in appearance like lutein cells, although no true corpora lutea are formed. He further states that in such cases sometimes continuous œstrus sets in. Evans[5], however, thinks that a pregnancy urine fraction (prolan) cannot work at all in the absence of the pituitary, and bases on this his theory of prolan action. It seems to us that our own extensive experimental material proves beyond doubt that A. P. L. does act on the ovary of the hypophysectomised rat, though this action is not the same as in the normal. Immature hypophysectomised females treated with A. P. L. fail to come into œstrus, whereas hypophysectomised adult females similarly treated show continuous œstrus (vaginal cornification) for days and even weeks. Immature females which have been injected for five days or more with A. P. L., in order to induce precocious puberty, and have then been hypophysectomised, also respond to continued A. P. L. treatment with continuous œstrus. It is clear that the response of the hypophysectomised female to A. P. L. is conditioned by the state of the ovary at the time of operation.

We have confirmed the finding of others that hypophysectomy leads to atrophy of the thyroid, adrenal cortex, and gonads, and to cessation of growth (which last, however, does not occur immediately in rats weighing less than 50 gm. at the time of operation); these processes are not checked by the administration of A. P. L. Nevertheless, A. P. L. does cause the appearance of pseudocorpora lutea in the ovaries of females hypophysectomised before puberty, and it evidently evokes a secretion of œstrin from the shrinking ovary of the adult hypophysectomised female, since ovariectomised hypophysectomised animals did not manifest an œstrus response.

We have also found that hypophysectomy of adult females, either immediately after parturition or later in lactation, leads very rapidly to retrogression of the mammary glands and failure of milk secretion; although maternal instinct is not impaired and the young still attempt to suckle until they perish. Neither control operations upon the sella turcica without removal of the hypophysis, nor ovariectomy, will lead to this failure of lactation.

We have also been able to confirm Smith's[1] finding that hypophyseal implants permit apparently complete replacement therapy; with alkaline extract of bovine hypophyses, we have obtained growth of hypophysectomised animals without checking the atrophy of the thyroid, adrenal cortex, and gonads.

J. B. COLLIP.
H. SELYE.
D. L. THOMSON.

McGill University,
Montreal, Canada.
Dec. 9.

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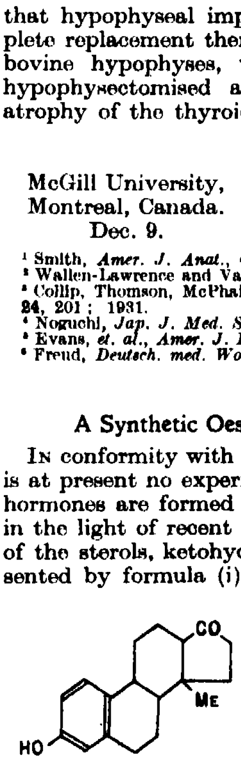
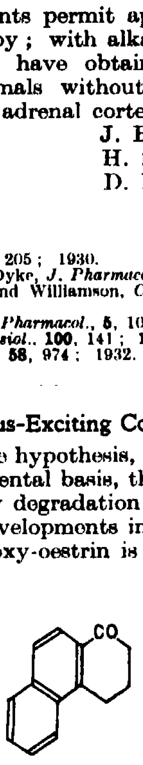
[1] Smith, *Amer. J. Anat.*, **45**, 205; 1930.
[2] Wallen-Lawrence and Van Dyke, *J. Pharmacol.*, **43**, 93; 1931.
[3] Collip, Thomson, McPhail and Williamson, *Can. Med. Assn. J.*, **24**, 201; 1931.
[4] Noguchi, *Jap. J. Med. Sci. Pharmacol.*, **5**, 104; 1931.
[5] Evans, *et. al.*, *Amer. J. Physiol.*, **100**, 141; 1932.
[6] Freud, *Deutsch. med. Woch.*, **58**, 974; 1932.

A Synthetic Oestrus-Exciting Compound

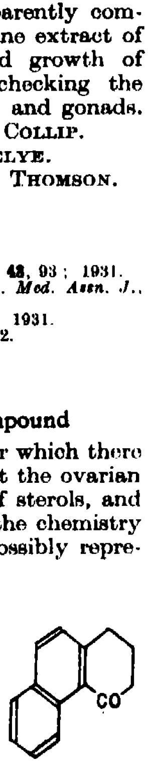
IN conformity with the hypothesis, for which there is at present no experimental basis, that the ovarian hormones are formed by degradation of sterols, and in the light of recent developments in the chemistry of the sterols, ketohydroxy-oestrin is possibly represented by formula (i).



(I)



(II)



(III)

This accords with all the facts supplied by the work of Butenandt[1], Marrian[2], and others, and we decided that the arguments in favour of this formula were sufficient to justify attempts to synthesise compounds of this nature. By analogy with other physiologically active compounds, it seems likely that a whole group of substances of related chemical constitution will be found to have oestrus-exciting properties, and the synthetic production of such substances would probably be of considerable clinical value.

We have found that 1-keto-1:2:3:4-tetrahydrophenanthrene (ii), which we propose to utilise as a starting point in the synthesis of a substance of formula (i), has itself very definite oestrogenic action, although the dose required is very large in comparison with oestrin. The oestrus-producing activity of the substance was examined by the Allen and Doisy procedure. The technique followed was that described by Allan, Dickens and Dodds[3]. The material was dissolved first in olive oil, and later in sesame oil. It was found that the substances were not readily soluble in olive oil, with the result that large volumes had to be administered subcutaneously to the ovariectomised animals. This proved to be unsatisfactory owing to leakage from the site of injection and intolerance to the oil, but with sesame oil the volume could be kept down to 2 c.c., and these adverse effects avoided. 25 mgm. of the substance in olive oil administered to ten ovariectomised rats produced no sign of oestrus, the animals remaining in a state of di-oestrus throughout the experiment. A batch of twenty animals injected with 50 mgm. dissolved in olive oil showed seven full oestrus responses, with three animals just short of the definition (a few leucocytes). In a series of twenty animals injected with 100 mgm. dissolved in sesame oil, a very much better response was obtained, all twenty animals going into oestrus. The oestrus in each case was complete.

In the case of the 50 mgm. dosage, oestrus appeared after 54 hours and terminated 150 hours after injection. In the case of the 100 mgm. in sesame oil, oestrus appeared after 52 hours. At the present moment, it is impossible to state the activity of the material in terms of oestrin since the relatively difficult solubility of the material together with the consequent difficulties of administration and absorption make a comparison impossible. Some form of 'cross-over' method must therefore be evolved. There can be no doubt that a repetition of the standardisation experiments with 50 mgm. dissolved in a small volume of sesame oil would indicate much greater potency than a similar experiment conducted with olive oil as the vehicle.

The observations show that 1-keto-1 : 2 : 3 : 4-tetrahydrophenanthrene is capable when injected into castrated animals of inducing oestrus of an exactly similar type to that obtained by the injection of oestrin. This result is of importance, for 1-keto-1 : 2 : 3 : 4-tetrahydrophenanthrene is the first compound of known chemical constitution found to have definite oestrus-exciting activity and furthermore, its molecular structure has many points of resemblance to the structure suggested for ketohydroxy-oestrin. There is thus provided the first step in the task of defining the molecular conditions necessary for this type of physiological activity, and there are grounds for hoping that substances of a much higher order of activity will be found before very long.

The observation[4] that oestrogenic properties of a low order are possessed by suitable extracts of such a variety of materials as peat, brown coal, lignite, coal tar and petroleum is of interest, but in view of the fact that many such materials are known to contain carcinogenic constituents, the clinical use of such extracts without very stringent refinement is scarcely to be entertained.

We have also examined 4-keto-1 : 2 : 3 : 4-tetrahydrophenanthrene (iii) and 3-hydroxyphenanthrene; these gave no oestrus response when injected in doses of 50 mgm.

We are indebted to Dr. H. Allan for kindly checking over the animal experiments.

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Courtauld Institute of Biochemistry,
Middlesex Hospital,
London, W.1.

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[1] *Z. physiol. Chem.*, **208**, 129; 1932.
[2] *J. Soc. Chem. Ind.*, **51**, 277 *T*; 1932.
[3] *J. Physiol.*, **68**, 348; 1930.
[4] Schering-Kahlbaum: Fr. Pat., 710,857.

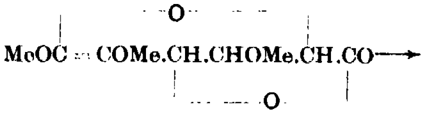
A New Unsaturated Derivative of Glucuronic Acid

COX, Hirst and Reynolds[1] in investigating Szent-Györgyi's hexuronic acid, have suggested that this acid may have the following structures:

$$\mathrm{COOH.CO.CO.CH_2.CHOH.CH_2OH} \rightleftarrows$$
$$\mathrm{COOH.CO.C(OH)=CH.CHOH.CH_2OH}$$

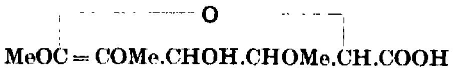
It will be noted that the second (enol) structure has a double bond. The acid reduces neutral silver nitrate, Fehling's solution, iodine and neutral permanganate[2], and yields a trimethyl ether and a triacetyl derivative.

In the course of recent work on glucuronic acid compounds of animal origin, we have methylated glucurone (the lactone of glucuronic acid) with silver oxide and methyl iodide, and obtained two crystalline methylated derivatives (see Pryde and Williams[3]), which were at first thought to be stereo-isomeric trimethyl glucurones. Further investigation has shown that only one of these compounds was trimethyl glucurone ($C_9H_{14}O_6$, m.p. 131°-132°, $[\alpha]_{5461}$ $+197 \cdot 5°$ in water). The second crystalline compound was found to decolorise rapidly permanganate and bromine water, and analysis showed it to contain two hydrogen atoms less than trimethyl glucurone. It has been called trimethyl glucuralone ($C_9H_{12}O_6$, m.p. 88°, $[\alpha]_{5461}$ $+ 110 \cdot 8°$ in water), on analogy with the glucals since we regard it as possessing a 1 : 2 unsaturated linkage[4] as follows:



$$\mathrm{MeOC{=}COMe.CH.CHOMe.CH.CO} \longrightarrow$$

Lactone



$$\mathrm{MeOC{=}COMe.CHOH.CHOMe.CH.COOH}$$

Acid

Its formation is ascribed to the mild oxidising action of silver oxide during the course of the methylation procedure, further oxidation being, no doubt, prevented by the substituent methoxyl groups. The suggested structure affords certain analogies to the enolic formula now ascribed to adrenal hexuronic acid, in that our substance would appear to be an unsaturated derivative of an aldo-uronic acid having (as the lactone) three free hydroxyl groups.

JOHN PRYDE.
R. TECWYN WILLIAMS.

Physiology Institute,
Newport Road, Cardiff.
Dec. 13.

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[1] NATURE, **130**, 888, Dec. 10, 1932.
[2] *Ibid*, **129**, 576, April 16, 1932.
[3] *Ibid*, **128**, 187, Aug. 1, 1931, and *Jour. Soc. Chem. Ind.*, **50**, 959 1931.
[4] R. T. Williams, Thesis, Univ. of Wales, April, 1932.

Mechanism of γ-Excitation by β-Disintegration

UP to the present, we have no system of relativistic quantum theory, and speculations about the process of emission of nuclear electrons may be permitted. In the recent work of Heisenberg, the stability of the nuclei relative to electron emission is treated on the basis of the energy balance conditions in such transformations. I propose to try to give here a detailed picture of electron emission and the excitation of the nucleus connected with it.

According to the views now generally accepted, every nucleus is built up of a number of α-particles, neutrons, and, for the elements of odd atomic number, one proton. The α-particles, possessing no spin, must be all placed on the same energy level, while on the other hand the neutrons must be distributed between the different energy levels inside the nucleus, two neutrons on each. The proton, having the same mass as a neutron, must have inside the nucleus approximately the same energy levels (differing by a constant, if we normalise to zero the potential at infinity) and in this sense may be assigned to the first neutron level.

Suppose now that for some reason one of the nuclear neutrons is unstable, and, releasing an electron, is transformed into a proton. We may suppose that it will be a neutron from one of the upper energy levels, as in this case the work of extracting an electron from the nucleus will be less. After the electron has gone, the remaining proton will find itself on the high energy level, and will fall, emitting energy in the form of hard γ-rays. If such a process takes place when the nucleus already possesses one nuclear proton, a new α-particle is formed and the γ-energy emitted will be somewhat larger.

This view explains at once why the β-disintegration is so often (in contrast to α-disintegration) accompanied by high energy γ-spectra of great intensity, and why the γ-rays emitted by odd elements are much harder than those emitted by even ones. This hypothesis on the mechanism of γ-excitation can also throw light on the results of recent experiments of Gray and Tarrant on the characteristic emission of stable nuclei under the action of hard γ-radiation. The hard γ-radiation falling on a nucleus interacts with one of the neutronial electrons (it can be shown that the action of γ-radiation on the heavy constituent part of the nucleus is very small) throwing it out from the nucleus. Just as in the case of natural β-decay, the remaining proton will fall, emitting characteristic γ-lines.

To test this theory, it will be of interest to look for the trace of emitted electrons and for the difference between the behaviours of even and odd elements. As the experiments of Gray and Tarrant deal only with the even elements (oxygen, iron, tin, lead), the investigation of an odd element, say copper, will be necessary.

G. GAMOW.

Radium Institute,
Leningrad.
Dec. 1.

Band Spectra which appear near Visible Triplet Lines of Mercury

RECENTLY, H. Kuhn[1] has found a band which appears very near the principal series lines of alkali metals in absorption and has explained this band as being due to the diatomic molecules loosely combined by Van der Waals' cohesion forces. In the case of mercury, it seems that bands of the same nature are also emitted very close to the visible triplet lines $2\,{}^3P_{0,1,2} - 2\,{}^3S_1$ which are not a principal series, in addition to the 2540 A. band beside the resonance line, and that these bands are well developed in the case of electrodeless excitation of the vapour with high-frequency oscillatory current.

In order to obtain a reliable spectrogram of such faint bands near the strong emission lines, it was, of course, necessary to take various precautions to obviate 'ghosts' and hallations of the plate. One of the microphotometric curves of the spectrogram in the near region of every visible triplet line is reproduced as Fig. 1. The upper corresponds to that obtained from the tube of the so-called reflux condensation type excited by an electric current of 10^8 cycles and the pressure of the vapour was estimated to be about 1 cm.; while the lower corresponds to that from an ordinary alternating current mercury lamp cooled with an air blast, which is used for comparison. From the upper curve, it is easily seen that the bands *a* and *b* on the red side and the band *c* on the violet side of the main lines appear well in this condition of excitation, and the long wave-length side of the bands *a* which appear beside the main lines are very sharply edged at 5467·7, 4362·6 and 4049·1 A. respectively. There are also to be observed several bands in the region between the sharp edges of the *a* band and the main lines such as the bands at 2540 A.[2] The wave-lengths of the *b* bands are measured as 4377·4 and 4053·1 A. respectively, while that of the *c* band is 4038·1 A. Other groups of bands of the same appearance are also observable in the neighbourhood of these triplet lines; whether they are connected with the lines or not is not clear. The maximum intensities are situated at 5492·7, 5483·6, 5473·5, 4364·8, 4064·1, 4060·8, 4050·4 and 4023·8 A. respectively.

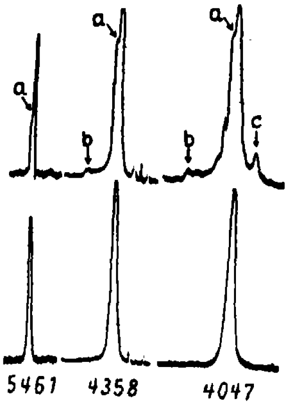

FIG. 1.

E. MATUYAMA.

Sendai, Japan.
Oct. 23.

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[1] H. Kuhn, *Z. Phys.*, 76, 782; 1932.
[2] H. Kuhn and K. Freudenberg, *Z. Phys.*, 76, 38; 1932.

Hyperfine Structure in Aluminium

FOLLOWING a suggestion of Prof. Paschen, that the hitherto unexplained doubling of several terms in Al II observed in his investigations of this spectrum[1] might be due to a nuclear moment, I undertook an examination of the structures of some aluminium arc and spark lines. The spectra were produced in a Paschen hollow cathode cooled by liquid air, following the method of Schüler. The tube was filled with helium. The lines were resolved with Fabry-Perot etalons which were silvered by evaporation for the visible spectrum and coated with Hochheim alloy for the ultra-violet spectrum. A reflection echelon was also used.

A very distinct hyperfine structure was found in the spark line λ 2669·166 $(3s^2)\ ^1S_0-(3s3p)^3P_1$, the line being double with the weaker component about 0·2 cm.$^{-1}$ to the longer wave-length side. This indicates a normal splitting of $^3P_1$ by a nuclear moment which is probably $\frac{1}{2}\,.\,h/2\pi$. Entirely in agreement is the doubling of the arc lines λλ 6696·07 and 6698·73 $(3s^2\ 4s)^2S_{1/2}-(3s^25p)^2P_{1/2,3/2}$ which are both split with a separation of about 0·04 cm.$^{-1}$ due to the ^2S term. Doubling is also clearly to be seen in the arc lines $(3s\ 3p^2)^4P_{3/2,5/2}-(3s\ 3p\ 4s)^4P_{5/2}$ at 3057·155 and 3050·073 A. classified by F. Paschen[2]. Fig. 1 shows the last mentioned lines as photographed at etalon separations of 10 mm. and 12 mm. In these lines probably both terms are split. Hyperfine structures in several other aluminium arc and spark lines have been observed, and the investigation is being continued.

Previous attempts to detect hyperfine structure in aluminium lines have been made by Gibbs and Kruger[3] and by Tolansky[4] who followed a suggestion of White[5] that Gibbs and Kruger's negative results did not constitute complete evidence against the existence of a measurable fine structure in aluminium. He did not succeed, however, in resolving any lines of Al I and III. Preliminary photographs of the arc lines λλ 3944·025 and 3961·537 found simple by the previous investigators have been taken with the reflecting echelon and seem to indicate a splitting of these lines also. From the present results, it is seen that aluminium has a nuclear moment and a not unusually small $g(i)$ factor.

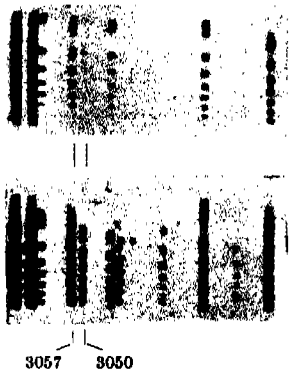

FIG. 1. Fabry-Perot patterns of the aluminium arc lines 3057A. and 3050A. Above, 10 mm. plate separation; below, 12 mm. plate separation.

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Berlin Charlottenburg.
Dec. 8.

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[1] *Ann. Physik*, 4, 71, 537; 1923; and 4, 84, 1; 1927.
[2] *Ann. Physik*, 5, 12, 509; 1932.
[3] *Phys. Rev.*, 37, 656; 1931.
[4] *Z. Phys.*, 74, 336; 1932.
[5] *Phys. Rev.*, 37, 1175; 1931.

Fixation of Mitochondria

DR. J. R. BAKER[1] has pointed out that, contrary to what has hitherto been accepted, mitochondria in animal tissues are not dissolved when lipide solvents and particularly acetic acid, are used in the fixative.

As regards plant tissues, Zirkle[2] states:—

(1) "Acetates do not give a basic fixation image and never preserve mitochondria."

(2) "Small traces of acetate will prevent the fixation of mitochondria regardless of the pH."

(3) "No matter how alkaline the acetate may be it never gives a basic fixation image. Always the hyaloplasm, nuclear lymph and mitochondria are destroyed. This is not only true when acetates are used alone but also when mixed with other reagents, for they penetrate so rapidly that they are the chief determiners of the fixation image."

(1) Using chromic acid 2·5 per cent, pH 1·0, he says:

"Mitochondria are nowhere preserved, though they are destroyed probably only in the outer part of the tissue, for when the fixed material is treated subsequently with $CuCr_2O_7$ (pH 4·6) some mitochondria are found in the central cylinder."

(2) Using potassium dichromate.

At pH 4·4, potassium dichromate containing no free acid gives a fixation image showing mitochondria in the outer part of the tissue, though owing to the slow penetrating power of the dichromate they are rarely fixed in the central cylinder. If the alkalinity of the dichromate be increased to pH 6·0, the fixation image shows mitochondria rather spherical in shape.

(3) Finally, according to Zirkle, the range of pH 4·2–5·2 in the use of dichromates is a "critical range". Fixation images on the acid side of this range show no mitochondria, while on the alkaline side the mitochondria seem to be quite well preserved.

I find that in a preparation of some root-tip material of *Althæa taurinensis*, which was fixed in La Cour's[3] 2 *BE* for the purpose of chromosome count, numerous mitochondria are observed, although the fixative contains acetates. The essential fixing agents in this fluid are chromic, acetic, and osmic acids, and potassium dichromate, and it has a pH of 1·8, while the fixatives used by Zirkle ranged in pH in the acetate series from 3·6 to 6·2, and in the chromate series from pH 1·0 to 6·2.

Dr. Baker suggests that the mitochondria are insoluble in acetic acid when they have a high protein content. The difference in pH between La Cour's fluid and those used by Zirkle would indicate, however, that the pH of the fixing fluid may determine whether mitochondria are soluble or not in solutions containing acetic acid.

The result which Dr. Baker obtains for animal cells would therefore appear to be equally true of plant tissues, but for a different reason from the one he suggests.

J. HUGH DAVIE.

Botany Department,
King's College,
University of London.
Nov. 25.

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[1] Baker, J. R., NATURE, 130, 741, Nov. 12, 1932.
[2] Zirkle, C., *Protoplasma*, 4, No. 2; 1928. Zirkle, C., *Protoplasma*, 5, No. 4, pp. 520, 528, 532; 1929.
[3] La Cour, L., *J. Roy. Micro. Soc.*, 51, 119–126; 1931.

Dimensions of Fundamental Units

A GREAT simplification in electrical and magnetic dimensions which is not adopted by Prof. W. Cramp[1] or emphasised by Prof. F. M. Denton[2] is obtained by admitting that as we cannot determine experimentally the dielectric and magnetic constants of space, we have no right to introduce k_0 and μ_0 representing these hypothetical quantities into our equations and should confine ourselves to the numerical k's and μ's of material media.

The omission of k_0 and μ_0 produces startling simplicity; the C.G.S. unit charge and unit pole both become 1 dyne$^{\frac{1}{2}}$ cm., the electrostatic unit of capacity becomes 1 cm., instead of 1 k_0 cm., and so on. Incidentally, I suggest that this method of indicating the dimensions of a physical quantity by giving one of the units commonly employed in measuring it has some advantages. The velocity of light in space, as the electromagnetic constant, c, comes naturally into all the equations connecting electrical and magnetic quantities—for example, the work done in taking a pole m round a closed path linking once with a current i is $4\pi mi/c$—instead of being hidden away as $1/k_0{}^{\frac{1}{2}}\mu_0{}^{\frac{1}{2}}$.

This way of regarding electrical dimensions appears to me to be much better than the $\mu_0\, k_0$ method and it is tacitly approved by all physicists who give capacities in centimetres instead of in k_0 cm. So far, however, I have only seen it formally adopted by German physicists.

As the writers of the letters quoted above have pointed out, fractional indices may be avoided by employing a unit of electricity as one of our fundamental units and writing, for dyne$^{\frac{1}{2}}$, C.G.S. unit charge per cm.

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Dec. 22.

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[1] NATURE, **130**, 368, Sept. 3, 1932.
[2] NATURE, **130**, 892, Dec. 10, 1932.

Catalytic Hydrogenation of Olefinic Compounds

IN a recent paper[1] it has been shown that the course of catalytic hydrogenation in a series of butadiene acids $R_1R_2C{:}CR_3.CR_4{:}CR_5.CO_2H$ varies from member to member when the operation is carried out with a platinum catalyst at room temperature and atmospheric pressure. More recent work shows that the figures then recorded for the proportions of the components of the reduction mixture at the stage of 50 per cent hydrogenation are by no means to be regarded as characteristic of the respective acids, since by using an 'aged' catalyst the course of hydrogenation of sorbic acid, $CH_3.CH{:}CH.CH{:}CH.CO_2H$, follows a course which is considerably different from that previously observed. Both the original and the new observations can be readily repeated.

The condition of the catalyst thus materially affects the relative extents to which $\alpha\beta\gamma\delta$-tetrahydrogenation and $\alpha\beta$-, $\alpha\delta$- and $\gamma\delta$-dihydrogenation occur simultaneously; consequently the nature and extent of substitution in the butadiene chains is not, under the conditions employed, the sole or apparently the most important influence in determining the course of reaction. The substitutional or constitutive influence (activating or deactivating) appears to be superimposed on a specific catalytic influence which of itself can activate both unsaturated centres of the conjugated system simultaneously.

Definite conclusions were reached several years ago by Lebedev and his collaborators[2] with respect to the order of reducibility (in competition) of (*a*) mono-, di-, tri- and tetra-substituted olefinic substances and (*b*) olefinic and conjugated di-olefinic substances. These conclusions, which were based largely on the form of the hydrogen-absorption curves (rate/time) for binary mixtures of mono- and di-olefinic substances, have now been rigidly verified, so far as numerous binary mixtures of Δ^{α}-, Δ^{β}- and Δ^{γ}-hexenoic acids, Δ^{γ}-pentenoic acid, allyl alcohol and sorbic acid are concerned, by chemical analyses of partial reduction products. Thus in the hydrogenation of sorbic acid, the whole of the conjugated acid disappears before the three isomeric ethylenic acids produced in the reduction suffer attack; moreover it is easy to follow quantitatively the disappearance, which proceeds at a constant rate, of the conjugated acid and the corresponding appearance of its saturated and ethylenic derivatives.

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R. A. E. GALLEY.

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and Technology,
London, S.W.7.
Dec. 8.

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[1] Farmer and Galley, *J. Chem. Soc.*, 430; 1932.
[2] Lebedev, Koblìansky and Yakubchik, *J. Chem. Soc.*, 417; 1925. Lebedev and Yakubchik, *J. Chem. Soc.*, 832, 2192; 1928.

Rate of Burning of Colloidal Propellants

IN a paper[1] recently published by F. R. W. Hunt and G. H. Hinds, use is made of physical data quoted by ourselves in a previous publication[2] dealing with the general problem of the combustion of colloidal propellants. They draw conclusions which are directly at variance with our own in the case of three out of the four propellant compositions considered, in that they deduce for the rate of burning a pressure law, as against the temperature-density law advanced by us.

In analysing the data they have adopted the hypothesis that a formula given by us[2], for assigning numerical values to the energy losses at the end of combustion, can when slightly generalised be applied to calculating the energy losses at any stage during the combustion. They have then proceeded to correct the pressure at each measured time interval, and in this way they have arrived at a hypothetical uncooled pressure-time curve (that is, the curve that would be presumed to have been obtained, had there been no energy loss at any instant during the explosion). From these values for uncooled pressure they have calculated corresponding fractions of charge burnt, and assuming no alteration in the time scale they have proceeded to apply a criterion to determine whether the rate of burning is proportional at any instant to their corrected uncooled pressure, or to their deduced gas density.

Such a procedure appears to be of doubtful validity. In the first place, the energy loss equation referred to was based on the assumption of a mean gas temperature holding throughout the burning, equivalent to that obtaining at the instant of complete combustion. This assumption was sufficient for the circumstances in which the formula was applied by us, namely, the assessment of the order of magnitude of a summation energy loss effect at the end of the explosion. A formula of this type, however, with an assumed average temperature and an appropriate fitting constant based on end conditions, cannot be used for assessing with sufficient accuracy varying temperature values during the burning for the purposes of any differential treatment, though it may yield values of approximately the right order of magnitude.

In the second place, even if for the sake of argument it be conceded that the formula may be put to such a use, the method adopted by Hunt and Hinds of calculating the value of the correction at each stage is open to objection. The main correction term depends on the value to be assigned to the fraction of charge burnt. This the authors have taken to be equal to the ratio of the observed pressure at any instant to the maximum pressure, an assumption which is unnecessary in view of the fact that they have available three equations by means of which the value of the fraction burnt, following their method, can be calculated, and the appropriate correction term deduced. Had they adopted this procedure they would have arrived at values differing from those they have actually employed.

Such difficulties always attend any attempt to deduce by differential methods the nature of the rate of burning law of propellants from experimental measurements of pressure and time only, and for this reason we have been led to investigate the possibility of ascertaining the temperature as well as the pressure at any instant during combustion. A technique for this purpose has been developed and experimental values are now being examined.

Although the analysis is not yet complete, the results so far available indicate that for the propellant compositions in question the rate of burning is in each case governed by a temperature-density law, and not by a pressure-law. We hope to be in a position shortly to publish details of our further investigations.

A. D. CROW.
W. E. GRIMSHAW.

Research Department,
Woolwich, S.E.18.
Dec. 13.

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[1] Hunt and Hinds, *Proc. Roy. Soc.*, A. **138**, 696; 1932.

[2] Crow and Grimshaw, *Phil. Trans.*, A. **230**, 387; 1932.

[3] Crow and Grimshaw, *Phil. Trans.*, A. **230**, 54; 1931.

The Bacterial Growth Curve and the History of Species

WHEN a nutrient solution is inoculated with a species of micro-organism, in pure culture, the curve obtained by plotting the population against the time is characteristic and conforms to a general type of growth curve; an initial period of slow increase in numbers being followed by a rapid rise in population which, in turn, is superseded by a decline. An example of such a curve, representing the growth of a species of *Actinomyces* (measured by the evolution of carbon dioxide) in glucose solution,[1] is given in Fig. 1. Winslow[2] recognises five phases in bacterial growth curves: (i) phase of adjustment, *A–B*; (ii) phase of increase, *B–C*; (iii) phase of crisis, *C–D*; (iv) phase of decrease, *D–E*; (v) phase of readjustment, *E–F*: it is worthy of remark that the diminution in numbers following the period of crisis appears to be due neither to a deficiency in the food supply nor to the formation of toxic substances.

The examination of a variety of natural growth phenomena supports the view that this type of growth curve is fundamental and of universal occurrence. It may well be that the history of each living species, at all events of the terrestrial forms, is represented by such a curve when its natural evolution is undisturbed by such abnormalities as geological upheavals and the advance of civilisation.

Assuming a new species arises as a mutation in an existing species or an existing species enters a new geographical zone, it would be anticipated that considerable difficulties would be encountered before the species becomes established, and this period would correspond to Winslow's phase of adjustment. During the phase of increase, which follows if the species can survive the initial stage, there will still be a considerable degree of instability which will be expressed in individual variation, and in this connexion it is relevant to note that H. D. and E. B. Ford[3] found that, in an isolated colony of *Melitæa aurinia* kept under observation for some years, an increase in the population corresponded to a marked incidence of variation. It is during this phase of increase that a species is most likely to extend its geographical range and also to give rise to new species, for the population is approaching a maximum and contains much highly variable material. With micro-organisms, the phase of crisis, during which the population remains constant, is invariably of short duration although it does not necessarily follow that this is the case with all organisms; but it may be that this stage marks the disappearance of the tendency towards variability and the cessation of the production of new species. Nevertheless, it would seem that the major portion of the life of a species is occupied by the final phases of decrease and readjustment in which there is a gradual decline in numbers and little tendency towards variability.

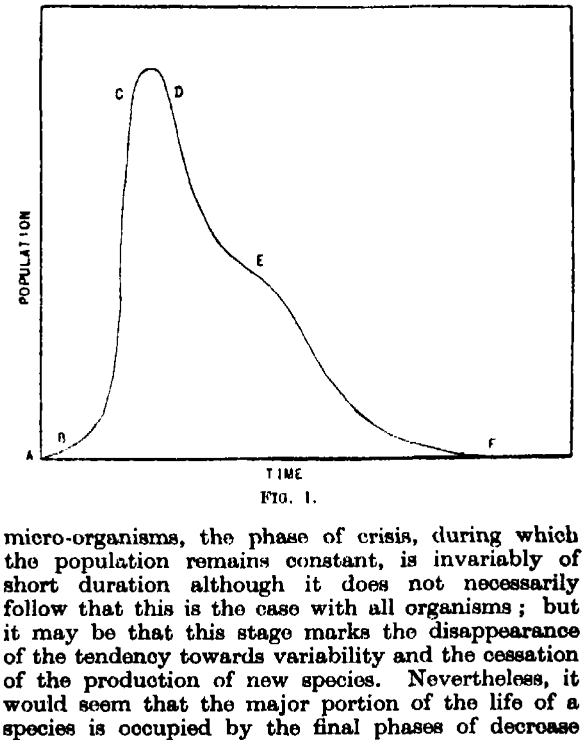

FIG. 1.

If these conclusions are correct, a comparatively young species will be characterised by (i) much individual variation; (ii) no well differentiated geographical races; (iii) a number of closely allied species in the genus. On the other hand, a species which had entered the final phases would exhibit (i) little individual variation; (ii) well differentiated geographical races; (iii) few or no similar species in the genus. It has been found that the species of Malaysian Rhopalocera in which the sex ratio is abnormally low have the characteristics associated with old species.

Close observation of certain Indo-Malaysian species of Rhopalocera over a period of five years has revealed that, so far as they can be tested, the conditions amongst these insects are compatible with the conclusions stated above, but the case of migratory species has not yet been examined and probably requires separate consideration. The Indo-Australian genera *Eurema*, *Amathusia* and *Ambly-*

podia all contain a large number of very similar species and doubt still exists as to the status of certain species in the last two genera named. *Eurema hecabe* and *Amathusia phidippus*, the two most widely distributed members of their respective genera, both exhibit marked individual variation, the geographical races are not readily separable, the sexes occur in approximately equal numbers and both so closely resemble certain allied congeneric species that determination is frequently a matter of doubt and difficulty. On the other hand, species such as *Papilio brookiana*, *Parcronia valeria* and *Ideopsis daos*, in which the females are strikingly rare, have well-defined geographical races but exhibit little or no individual variation and have no close allies. Such instances can be multiplied.

Application of the views expressed here to mimicry amongst Malaysian butterflies is of great interest. The models of the 'true' mimetic butterflies of the Malay Peninsula are members of the Aristolochia group of the genus *Papilio*, the genus *Delias* or the family Danaidæ, and the larvæ of these are known to feed on plants containing toxic substances. As a rule, the mimetic butterflies are rare but, in cases where their habits are sufficiently known, they are found to have the characteristics of old species, having no close allies, a low sex ratio and exhibiting little individual but marked subspecific variation. This state of affairs suggests that the mimetic forms have ancient wing patterns which have been preserved through the agency of natural selection owing to the advantages associated therewith.

The equable conditions of life prevailing in the tropics, which must be of considerable assistance to new species during their early struggles for existence, and the large number of broods produced annually, indicate that it is in equatorial regions that most new species have been produced.

It is hoped that, at a subsequent date, it will be possible to discuss the evidence which supports these arguments in greater detail than is permissible here.

A. STEVEN CORBET.

"Elm Lodge", Elm Road,
Earley, Reading.
Nov. 1.

[1] Corbet, A. S., *Rubber Research Institute of Malaya Journal*, **3**, 16; 1931.

[2] Winslow, C. E. A., "Newer Knowledge of Bacteriology and Immunology" (Univ. Chicago Press), p. 56, 1928.

[3] Ford, H. D., and Ford, E. B., *Transactions of the Entomological Society of London*, **78**, 345; 1930.

Glycogen in Cartilage

WE were much interested in the letter from Prof. H. A. Harris in NATURE of December 31, p. 996, in which he directs attention to the presence of glycogen in hypertrophic cartilage cells and correlates this with a secretion of phosphatase by these cells.

We feel, however, that it should be made clear that phosphatase is also actively secreted by the osteoblasts[1,2]. According to Prof. Harris, "osteoblasts and highly vascularised bone contain no glycogen". These facts are not necessarily inconsistent with the suggestion that he has put forward.

Prof. Harris in his letter refers to the hypertrophic cartilage as "senescent". Although hypertrophic cartilage, being a transitory structure, may eventually become senescent (degenerative), the process of chondroblastic hypertrophy is not in itself a degenerative change but a specific differentiation. One of us (H.F.) formerly held the contrary view, but was forced to a change of opinion on finding that undifferentiated cartilage rudiments, when isolated and cultivated *in vitro* under standardised environmental conditions, only developed areas of hypertrophic cartilage if destined to do so in normal development, and only in that part of the rudiment where hypertrophy would normally have appeared[2,3]. Degeneration may occur in small-celled cartilage *in vitro*, but in such tissue we have never found any histological appearance at all suggestive of the chondroblastic hypertrophy characteristic of an ossification centre. Moreover, the secretion of phosphatase in cultures of either hypertrophic cartilage or of osteoblasts is always correlated with a healthy condition and not with regression, as indicated by the fact that in unhealthy, though surviving cultures, one of the first cellular activities to disappear is the production of phosphatase.

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R. ROBISON.

Strangeways Research Laboratory,
Cambridge.
Listor Institute, London.

[1] Martland and Robison, *Biochem. J.*, **18**, 1354; 1924.

[2] Fell and Robison, *Biochem. J.*, **24**, 1905; 1930.

[3] Niven, *J. Path. and Bact.*, **34**, 307; 1931.

A Peculiar Visual Experience

IN NATURE of December 10 (p. 888) Dr. K. Mackenzie describes visual sensations consequent on the sudden subjection of his eyes to a brilliant flash. A similar experience of my own may therefore be worthy of record.

At the end of June, 1922, I was bicycling from King's Lynn to Leicester. It was a fine morning and the sun was of course behind me, when a motor-car, meeting me suddenly, unexpectedly flashed the sun from its wind-screen straight into my eyes. Shortly afterwards I seemed to see splashes of blood on the road. My sight was a bit troubled, but as the appearance was pronounced and persistent I dismounted to examine the road, and found that the red was in my eyes. Riding on I noticed that the red splashes had changed to green, which after a time died away.

I cannot estimate the duration precisely, but it was considerably longer than the ninety seconds noted by Dr. Mackenzie. The circumstances were not conducive to precise observation. The importance of the experience to me is that occasionally during the following years I have noticed brief repetitions of the appearance, generally taking the form of an irregular but defined blotch, and ending in white with a purplish border. It was apparently only the right eye that was affected, at least permanently, and about two years ago it became obviously difficult to read with it. It seemed that there was a lesion of the retina over the central area and this was confirmed by an oculist. The affection is most noticeable when rising in the morning or when looking from relative darkness into a bright light.

It is true that my eyes, especially the right one, have been subjected to fairly severe use throughout fifty years, but it is to this particular experience that I refer the damage, and I would suggest to Dr. Mackenzie that he should for the present rest his eyes as much as possible and consult an oculist without delay.

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Dec. 14.

Research Items

Archæological Researches in the Argentine. At the time of his death in 1924 the late Dr. Eric Boman left in manuscript an account of his archæological investigations in La Rioja in 1914, in a series of papers which have now been edited and published by his colleagues (*Anales Mus. Nac. Hist. Nat. Bernardino Rivadavia*, Buenos Aires, vol. 35). These papers deal with excavations on several sites which produced a limited amount of skeletal material, interesting for the light it throws on the distribution of artificial deformation of the head, and a quantity of painted pottery with designs both geometric and conventionalised, as well as a number of figurines. The first paper of the series is devoted to a description of three sites or cemeteries in which were found a number of urn burials of infants. The skeletal remains were much decayed and little remained which could be submitted to osteological examination. From the teeth, however, it was possible to deduce that the range of age was from three months to about five years, or a little more; while Dr. R. Lehmann-Nitsche, to whom the skeletal fragments were submitted, was able to arrive at certain deductions as to the proportions of the long bones and the changes in course of growth as compared with Europeans. The pottery was hand-made, well-fired, and belonged in the main to two types. In form, the urns were either globular with mouth either circular or elongated, or bell-shaped. They were painted with a variety of conventional designs. Many of the pots had covers formed by inverted pots and a number, in addition to the skeletal remains, contained small pots or calabashes which probably had contained food or drink for the deceased infant. Small pebbles had been scattered over the bodies. Notwithstanding the distance between the cemeteries, the similarities point to an identity of race.

Fishes from the Tonga Archipelago. A small collection of fishes is described by Mr. Henry W. Fowler ("The Fishes Obtained by Lieut. H. C. Kellers, of the United States Naval Eclipse Expedition of 1930, at Niuafoou Island, Tonga Group, in Oceania." No. 2931. *Proc. U.S. Nat. Mus.*, vol. 81, Art. 8. 1932). This is the basis for the first report ever published on the fishes of Niuafoou Island, Tonga Archipelago. Two hundred and seventy-two specimens are represented by thirty-five species, three of which are new: *Paramyxus Kellersi* (belonging to the family Echelidæ); *Salarias Kellersi* and *Salarias niuafooensis* (belonging to the family Blenniidæ). These new forms are figured in the text, the two *Salarias* species being very handsome additions to the genus, especially the latter, which has a peculiar and characteristic pattern on the upper lips and lower surface of the head extending under the chin as dark bands. The fishes altogether belong to seventeen families and twenty-five genera most of which have one or two species, *Salarias* having seven.

Land Leeches. Prof. J. Percy Moore, who has spent a season in India in the study of land leeches, contributes observations (*Rec. Indian Mus.*, vol. 34, pt. 1, 1932) on their biology, especially in the Darjeeling district and in Sikkim. The common small grass leech (*Hæmadipsa zeylanica montevindicis*) ranges in altitude from 800 ft. to 11,200 ft.; the range of other species is much more restricted. Prof. Moore states that the accounts of several previous observers represent land leeches as far more numerous than they actually are. He examined every locality within reach where they were reported to be excessively abundant, but rarely did he find them to exceed six or eight per square foot. Only during July when the south-west monsoon was well advanced and young leeches were hatching in large numbers were 14–20 a sq. ft. counted in a few cases, and only rarely would several contiguous square feet yield so many; on many square feet none would be present. On 100 sq. ft. taken at random over an acre of good leech ground, the average was 1·8 a sq. ft. On this ground were places where leeches were present in such numbers as to give the impression of great abundance, but the largest number counted on one square foot was 13 and in places one might walk fifty paces unmolested by them. *H. sylvestris*, which is widely dispersed in the fields during the rainy season, congregates during the dry season at low places where a little water or mud may remain and generally in shade. Leeches are incapable of leaping as some observers have stated, and as the results of experiments on *H. sylvestris*, Prof. Moore concludes the land leeches not only do not swim but also have lost the effective swimming reflexes. He could find no evidence that leeches feed on plant juices.

Influence of Sodium and Potassium Ions in Yeast Growth. Buchner's results render it probable that the efficacy of yeast or lactic acid bacteria in the treatment of boils depends, not merely on the suppression of pathogenic organisms in the intestines by the vigorous growth of the added micro-organisms, but partly on the purely fermentative actions of the enzymes of the yeast or bacteria. The results of several series of experiments described by Prof. Ivo Novi in the *Rendiconti della Reale Accademia delle Scienze dell' Istituto di Bologna* (vol. 34) show that yeast itself and the enzymes it contains are affected differently by variations in the containing medium. The presence of 0·5 per cent of sodium chloride retards the development of yeast, and 3–6 per cent inhibits growth and favours autolysis. Multiplication of yeast is, however, accelerated by 0·5–2 per cent of potassium chloride, and as much as 5 per cent does not stop growth. The glycolytic power of yeast killed by heating at 100° C. is, however, activated by either sodium or potassium ions in the proportion of 1 per cent (as chloride), but if this concentration is raised to 3, 6, and 16 per cent, the effects on the glycolytic power are the opposite of those exerted on the yeast cells.

Trials of Fruit Trees. The very extensive trials of new varieties of hardy fruit trees carried out by the Ministry of Agriculture and the Royal Horticultural Society have produced a crop of extremely interesting results ("Trials of Varieties of Hardy Fruits for Commercial Purposes." *J. Roy. Hort. Soc.*, 57, pt. 2, pp. 246–286). Owners of new varieties of fruit which showed promise when exhibited at the Royal Horticultural Society's shows at Vincent Square were invited to send grafts, plants or cuttings to Wisley. They were propagated on suitable stocks and were distributed to a number of sub-testing stations embracing wide variations of soil and climate. It is now possible to form an exact estimate of the value of a new introduction for commercial use in any particular area. The trials include apples, pears, plums, cherries, currants, gooseberries, raspberries, blackberries, strawberries and nuts. Each variety is estimated for yield, suitability for market, and resistance to disease and is compared with the performance of established varieties. Canning tests have also been made. Two interesting appendixes are added to the report. One states the most desirable characters of the various fruits for different purposes, whilst the other describes some of the varieties distributed for trial.

Silkstone Coal Seam of Yorkshire. Nowadays much attention is being paid to the problem of promoting the use of British coal and it is a legitimate criticism that the coal industry in its days of prosperity made little effort to accumulate and publish reliable data about its wares. Now the industry is fortunate in having this done for it by the State in its survey of coal resources. Survey Paper No. 25 (H.M. Stationery Office. 1*s.* 6*d.*) on the Silkstone Seam of South Yorkshire discloses a fuel of such high class as to deserve the greatest publicity. The seam is generally low in ash and moisture and the harder portion is justly celebrated as a house coal. The softer portions have all the most desirable properties of a coal for carbonisation either in gas works or coke ovens. In this respect its low content of alkali chloride is advantageous in minimising the destructive action of alkali on the refractories of carbonising plant.

Plan of Hochelaga. In the Italian translation by Ramusio of Cartier's "Voyages" published in 1556, there appeared a plan of Hochelaga, the Indian settlement adjoining the site of Montreal. This plan has since been accepted with deference and reproduced as authoritative, as in Biggar's "Cartier". In a recent paper (*Trans. Roy. Soc. Canada*, Section 2, 1932), Mr. W. D. Lighthall shows that the plan is not only misleading and contrary to Iroquois custom, but is also a fiction of Ramusio's engraver and was probably never seen by Cartier himself. The plan showed a circular 'town' surrounded by a palisade of scantling and sawn planks unknown to the Indians. It showed square instead of elongated houses and a disposition within the stockade quite out of keeping with the arrangement known from Champlain's pictures of Iroquois towns. From Cartier's description of the town and its site, Mr. Lighthall has drawn a new plan and located its position on the map of modern Montreal. He gives Hochelaga an octagonal shape with a diameter of about 600 feet and places it immediately to the south of the McGill University grounds.

A Gaseous Oxidation. Ritchie and Ludlam (*Proc. Roy. Soc.*, Dec.) have studied the reaction between sulphur vapour at low constant pressure and oxygen at an initial pressure of about 4 mm. The reaction vessels were provided with independently heated inner tubes of quartz or pyrex glass. The oxygen disappeared from the reaction vessel when one of these surfaces was maintained at about 500° ; and when the sulphur dioxide was rapidly removed from the reaction vessel the reaction once initiated continued after the inner tube had been cooled. The rate of the reaction was practically independent of the oxygen pressure. The process appears to be a chain reaction which is initiated at the hot wall. Sulphur dioxide is an inhibitor which breaks the reaction chains, and the steady progress of the reaction is controlled by the removal of the sulphur dioxide. When the oxygen pressure is raised, the diffusion of sulphur dioxide is hindered and the reaction velocity does not rise. The authors give a tentative explanation in terms of sulphur dioxide inhibition of the fact that the reaction always ceases while there is still a residual pressure of oxygen.

Astronomical Topics

Frequency of the Nova Phenomenon. Lund Observatory Circular for June 1932 contains a paper on this subject by Conrad Lönnqvist. He begins by noting the fact, first announced by Dr. Lundmark in 1923, and further confirmed by later research, that the absolute magnitudes of novæ at maximum are nearly constant, the weighted mean being − 6·1 mag. The novæ in the Andromeda nebula exhibited the same phenomenon, and gave a measure of the distance of the nebula, 930,000 light-years, practically the same as Hubble's determination from the Cepheids.

Accepting this result, it is possible to deduce the distance of each nova from its apparent magnitude at maximum, and consequently to find the frequency of novæ in a given volume of space, which can be compared with the estimated number of stars in that volume. In this manner, he estimates that on the average each star undergoes a nova outburst about once in 400 million years. The general order of magnitude of this period is fairly well established, but it may need multiplication by a factor ranging from 3 to 1/3. The geological record is considered to make it evident that the sun has not experienced such an outburst in the last 1,000 million years. It is noted that the distribution of novæ along the galaxy is far from uniform, and it is conjectured that regions where dark nebulosity is present, notably Sagittarius, are more subject to such outbreaks. The distribution of novæ in the Andromeda nebula is stated, on Hubble's authority, to favour the suggestion: many of them are in the dark lanes.

Bright Lines in Stellar Spectra. The number of stars now known to possess bright hydrogen lines in their spectra is steadily increasing, and it has been suggested that some may have developed this characteristic within recent times. This fact, together with the difficulties encountered in theoretical explanations of such stars, and with the well-known variations which are frequently found, render observations of this type of spectrum of considerable importance. A useful list of *Be*-type stars has recently been published by Merrill, Humason, and Miss Burwell (*Astrophys. J.*, 76, 156) in continuation of a previous list which was published in 1925.

The number of such objects discovered at Mount Wilson Observatory is 233, of which 138 make up the later list. The method of search is to examine the $H\alpha$ line, which shows the effect most strongly. In some cases this is the only emission line present, and in all cases the intensity of emission decreases in the Balmer series towards the ultra-violet, the later members being simple absorption lines. The authors give the intensities of all the hydrogen emission lines, and of the dark ultra-violet lines, as well as a considerable amount of miscellaneous information. They find that bright $H\alpha$ and $H\beta$ lines reach their maximum intensities in stars of types $B0 - B3$; and another interesting fact which emerges is the existence of a reddening effect in some of the fainter stars which may be due to the absorption of light in space.

Annual Meeting of the Science Masters' Association

THE thirty-third annual meeting of the Science Masters' Association was held on January 3-6 at the University of Bristol. The programme consisted almost entirely of a number of lectures given by the heads of various departments of the Faculty of Science of the University. In addition, a large number of visits were arranged, including a very popular one to Clifton College, where the Science School was inspected.

In his presidential address, Prof. A. M. Tyndall, director of the Henry Herbert Wills Physical Laboratory, made a departure from the traditional form in that he gave what was virtually an experimental lecture on "Gaseous Ions". His aim was to avoid a highly specialised discourse on some physical topic in an endeavour to claim the attention of the biologists, while still maintaining the interest of the physicists by a judicial selection of experiments. For the most part, his demonstrations were performed with the most simple apparatus in order to provide material which might be easily adapted to school conditions. He illustrated the methods of production of ions by means of coloured powders and soap bubbles, the phenomena of conduction, and the variation of velocity of movement of ions with their radius. Of historical interest was the reproduction of an experiment of about 1740 due to Abbé Nollet. An electrostatic charge was conveyed by thermal ions, produced by the flames of two candles, along a piece of wood, from a Wimshurst machine to an insulated ball, which, on receiving the charge, attracted small particles of paper from the surroundings. After a group of demonstrations on high-speed ions and their ionising power, Prof. Tyndall discussed shortly current theories regarding the nature of cosmic rays. Their existence in the room, despite the lead roof, was shown by a process of magnification by a Geiger counter and a three-stage amplifier. A series of sharp notes on a loud speaker proclaimed their arrival. During a brief survey of the causes of atmospheric electricity, he performed an experiment supporting the old Simpon theory, and appropriately concluded with his "attempt at lightning" which he demonstrated last year to the "children's auditory" at the Royal Institution.

Prof. W. E. Garner, Leverhulme professor of physical chemistry in the University, lectured on the "Decomposition and Detonation of Solids". He pointed out that only in exceptional cases is the liberation of gas from the interior of a crystalline lattice possible. Such a fact is in agreement with the calculations of Kossel and Stranski, who have shown that reaction centres should occur chiefly on the edges and surfaces of a solid. Decomposition results in the formation of a new interface, and it is found that the rate of reaction is proportional to its area in irreversible processes, where there is no impedance by the products. This is illustrated in the case of lead azide and in endothermic changes generally. The reaction takes place when one ion absorbs sufficient energy to set it in vibration and so allow it to pass its energy to other ions by collision. The detonation wave is probably caused by four adjacent azide ions decomposing simultaneously. With lead styphnate and barium azide there is, in contrast, an initial induction period and decomposition occurs throughout the whole mass of the crystal. The change, which follows a simple exponential law here, is a chain reaction with infinite chain length, and whereas detonation can only occur when the decomposition is accelerated, with lead azide it may take place at any stage of the reaction.

Prof. Sutton Pippard, professor of civil engineering, deliberately chose a comprehensive title for his talk, "The Contribution of Science in the Development of Aeronautics", in order that he might depict how the progress of aviation has depended solely on the close co-operation of science and practical engineering. The combination of the worker in pure science, who has no interest in practical results but can assimilate something of the engineer's outlook, and the engineer, who can appreciate the value of theoretical considerations and experimental research and give them some tangible form, has been a most powerful and happy one. From the inception to the first flight, advanced mathematical analysis and accurate experimental work must always be in contact. While admitting such a debt to science, Prof. Pippard emphasised, however, that the development not only in the theory of structures and elasticity, but also in meteorology, archæological research and geographical survey, has resulted in no small measure from the study of aeronautics.

In his lecture on "Neuro Humoral Mechanisms", Prof. R. J. Brocklehurst, professor of physiology, showed that in several instances the results of nerve activity can be adequately explained by postulating the liberation of a chemical substance which intermediates between the nerve and the tissue which it innervates. Loewi has demonstrated the probability of acetyl choline appearing in the heart after vagal stimulation and Lewis has brought forward evidence that a vaso-dilator substance, a histamine-like compound, is produced locally at nerve endings in the cutaneous blood vessels on antidromic stimulation or as a result of local axon reflexes. It is this substance, and not the injurious agent in a mechanical manner, which stimulates the sensory nerve endings. Prof. Brocklehurst is to be congratulated on his choice of subject since it is becoming one of increasing importance, but as yet has found no place in current physiological textbooks.

"The Geology of the Bristol District" was the subject of a lecture by Prof. S. H. Reynolds, professor of geology. Besides possessing all formations with the exception of the Archæan, Ordovician, Permian or Tertiary, the district is fortunate in having two of the finest sections of carboniferous limestone (in the Avon Gorge and at Burrington Combe) to be found in Europe, or possibly the world. A special feature in the Mendips is the way modern erosion has reproduced most of the pre-Triassic topography.

So popular was the address given by Prof. M. W. Travers on "The Discovery of the Rare Gases" that many members were required to stand until further accommodation had been provided. Only three phases of the story were related—the discovery of argon and the separation and isolation of neon. Interest was enhanced by the many personal reminiscences, and by lantern slides showing the laboratories and apparatus used in the original research.

The lecture demonstration of Dr. S. H. Piper on "Laboratory Vacuum Technique" was concerned with modern developments and the methods now used, since such facts are more accessible to universities than to schools. He dealt particularly with the alloy- and metal-glass seals now available, and prophesied the general use of low vapour pressure hydrocarbon oils, as prepared by Birch, in diffusion pumps. The demonstrations were of great beauty and special mention may be made of three—the method of preparing electrostatic screens *in vacuo* by distillation of metallic silver, the renewal of alkali metal traps by passing sodium ions electrolytically through soda glass, and finally the use of magnesium as a 'getter', the distillation being effected by means of electron bombardment.

The concluding address, the subject of which had been puzzling members for some time, was given by Dr. MacGregor Skene on "Charles and Erasmus". He was referring to Erasmus Darwin and his famous grandchild, who still remains, said Dr. MacGregor Skene, the greatest and best protagonist of his evolutionary theory.

The trade exhibition of apparatus and books was held in the Physics Department. There were many examples of good workmanship, especially the epidiascopes, which were displayed to full advantage in the optical laboratories. The bakelite cases for balance weights were interesting. Of outstanding interest was the display of the cycle film by Messrs. Dance-Kaufmann. This formed the subject of a demonstration and discussion initiated by Mr. H. E. Dance. The value of such films was at once apparent in the illustration of the theory of wave motion, and of the three-phase induction motor. An advantage is that only one effect is illustrated at a time, hence the teacher never loses control due to excessive detail, as is often the case in documental films. The projectors, equally adaptable to continuous and stationary films, may be operated by hand, or, in the more expensive model, by an electric motor, and can be used in daylight. The conditions of the demonstration were, throughout, those likely to be found in the class-room. The manufacturers are desirous of producing additional films of an educational type and wish to have the co-operation of science masters in editing these.

The conference, which by general agreement had been one of the most successful of recent years, ended fittingly with a tour to Cheddar in most glorious weather. F. C. TOMPKINS.

Lectures at the Physical Society's Exhibition *

MEASUREMENT OF SURFACE TENSIONS

THE first of the evening discourses associated with the Physical Society's twenty-third annual exhibition at the Imperial College of Science and Technology was delivered on January 3 by Dr. Allan Ferguson on "Surface Tension and its Measurement". Simple illustrative experiments were appealed to in order to demonstrate the existence of a surface tension in liquid films and surfaces, and the variation of this tension with temperature and with the nature of the liquid. Conditions of instability were illustrated experimentally, and it was pointed out that a knowledge of the *quantitative* laws governing these phenomena, together with an appeal to the principle of minimum potential energy, would go far to elucidate otherwise obscure phenomena.

Of the quantitative laws, the power law connecting surface tension and temperature, and Macleod's law connecting surface tension and density, together with the law of rectilinear diameters, give formulæ which represent very closely the temperature variation of liquid and vapour density, and of free and total molecular surface energy.

Conditions of drop formation were demonstrated and the formation of aniline drops in water was shown by projection, and also by means of a slow motion cinematograph film. The impact on a solid surface of an aniline drop in water was also demonstrated cinematographically, as were some of Worthington's results for the impact of liquid drops on liquid and solid surfaces.

A brief discussion was given of the principal methods for the measurement of surface tension. Simple conditions for the production and photographic measurement of large flat bubbles were reviewed, and it was pointed out that the method can be successfully used for the measurement of interfacial tensions.

Quantitative determinations of the surface tension of benzene were made by the capillary rise method, by means of the pull on a plate, and finally, by a method which involves the use of no more than a few cubic millimetres of liquid, a knowledge of its density being unnecessary. The methods were in each instance so arranged as to be direct-reading on scales visible to the audience.

CATHODE RAY OSCILLOGRAPHY

Mr. R. A. Watson Watt's lecture on January 4 at the Physical Society's Exhibition touched on a variety of aspects of cathode ray oscillography. He referred to 'domesticated oscillograms', the electrically-recorded gramophone record and the sound-track on the 'talkie' film, as illustrating the problems and limitations of oscillography, and then proceeded to discuss the special merits of the cathode ray oscillograph. It provides a radical solution of the opposing requirements of low inertia and high photographic effect which face the designer of mechanical oscillographs, it has an exceptionally high overload capacity, and the high-voltage type is ultimately limited in speed of operation only by the errors due to the finite time of transit of the indicating electrons through the deflecting field produced by the E.M.F.'s under examination.

Mr. Watson Watt showed slides of oscillograms, one delineating wave trains of frequency 25 million per second, corresponding to a wireless wave-length of 12 metres, and another of still higher frequency phenomena in which a trace described in 10^{-9} sec.—the time taken for light to travel 30 cm.—was clearly recorded. In this latter case the electron velocity in the recording jet was about half that of light, the transverse writing speed about one-fifth that of light.

Turning to the low-speed sealed-off oscillograph, Mr. Watson Watt enumerated the residual defects, mainly due to the gas content utilised as an aid to focusing, which still mar slightly the remarkably fine performance of modern tubes of this simple character.

The lecture was illustrated by demonstrations using eight oscillographs in all, a battery of five in parallel arranged around the lecture theatre, and three independent tubes of special construction. A demonstration of particular interest was the optical projection, throughout all the experiments, of the moving screen image from the central tube of the paralleled group on to a screen approximately two feet square, with a tenfold magnification. This projected image was clearly visible from the back of the theatre although an accelerating voltage less than 2,000 was used on the tube. There was a striking contrast between the red fluorescence of the 'port' member of the group and the brilliant green of the 'starboard' tube.

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* The lectures are being published in the February issue of the *Journal of Scientific Instruments*.

In addition to experiments showing the applications of the oscillograph in radio research, Mr. Watson Watt exhibited a cinematograph film from the same field. The most novel section of the film might, he suggested, be called "Sturm über Europa", as it represented a single minute of the thunderstorm history of Europe. The places of origin of individual atmospherics—located by simultaneous cathode ray cinematography on a base-line Slough-Leuchars—were indicated by bright flashes on a dark map of Europe, the timing of the flashes reproducing accurately the times of incidence of the individual atmospherics. The film showed that, within a single half-minute of recording, lightning flashes in mid-Atlantic, the North Sea, Denmark, Germany, Hungary, the Balkans, and France had contributed to the stream of atmospherics affecting Great Britain.

The lecture concluded with demonstrations of the variety of colour and duration of afterglow in screen materials, of the control of brightness by a Wehnelt cylinder, and of the applications of oscillographs fitted with Faraday cages to operations in which oscillographic response and relay control are combined.

The oscillographs used in the demonstrations were lent by the manufacturers, Messrs. A. C. Cossor, Ltd.

TIME MEASUREMENT: OLD AND NEW

The last of the evening discourses at the Physical Society's exhibition was given by Mr. Hope-Jones on January 5 on "Time Measurement: Old and New". With the kind permission of Sir Henry Lyons, the director of the Science Museum, he was enabled to begin his lecture by exhibiting the Dover Castle clock, still going, although a relic of the fourteenth century. He showed lantern slides of the half-dozen known examples of this period, de Vick, Wells, Cassiobury, Salisbury, Porlock and Dinan, and expressed the hope that others will be found to have escaped the scrap-heap or restoration by a vandal clockmaker.

Mr. Hope-Jones traced the origin of the astronomical dial (a few of which survived the dissolution of the monasteries, such as Glastonbury, Wells, Wimborne and Hampton Court) from the Ptolemaic or geocentric conception of the universe, and showed models of Galileo's and Huyghens' escapements which harnessed the pendulum to wheelwork, thus bringing to a close the medieval period of 300 years during which the only known regulator for clocks and watches was the *Foliot* balance.

The halcyon days of English clock-making, inaugurated by Robert Hook, Harrison, Arnold and Earnshaw were discussed, and Mr. Hope-Jones deplored the fact that when Tompion and Graham were laid to rest in Westminster Abbey, the science of accurate time measurement died with them, or rather remained for two hundred years exactly in the condition in which they left it. He attributed this to the escapement, which had 'mesmerised' horology for so long, and showed how the "Synchronome" remontoire produces perfect freedom of the pendulum by coupling two together as 'master' and 'slave', a feat accomplished by Mr. Shortt's invention of the hit-and-miss synchroniser.

The extraordinary effects of the new standard of time-keeping set up by this clock were rapidly reviewed: how it caused the astronomers to invert their methods of producing rate charts; how it revealed nutation and necessitated a revision of the definition of time in the Nautical Almanac, and finally how the lunar period appeared in comparison with the crystal clock, although the change in the value of G only affects the rate by 2/10,000 sec. at maximum between lunar noon and midnight.

Prof. C. V. Boys has dubbed Mr. Hope-Jones as a modern Saint Athanasius, saying "this is the clock faith which, unless a man believe faithfully, he cannot be saved", subscribing to its articles himself, "with the possible reservation of some of its damnatory clauses". Whilst discouraging the use of the new synchronous motor clock for the time equipment of large buildings and institutions, Mr. Hope-Jones proclaimed the engineers of the electric light and power stations as the future time-keepers of the nation, and described means of assisting them to keep their turbo-alternators running true to average Greenwich Mean Time.

Annual Meeting of the Mathematical Association

THE annual meeting of the Mathematical Association was held in London at the Institute of Education on January 5 and 6. The most notable features of the meeting were the presidential address by Prof. G. N. Watson and a discussion on "The Study of Statistics in a School Course". Prof. Watson's address had the mysterious title of "The Marquis and the Land Agent; a Tale of the Eighteenth Century". It was revealed as a topic from the history of mathematics. The speaker regretted that as a pure mathematician he could not speak on some popular subject from the 'real' world of the applied mathematician. Neither could a popular discourse be made on those researches into singular moduli which had engaged his leisure during the past two years. Pedagogical problems he regarded as of secondary importance. Only a historical subject remained.

The Marquis of the title was the Italian mathematician Guilio Carlo, Count Fagnano and Marquis de Toschi (1682–1766). English textbooks refer to him as Fagnano and mention a theorem concerning elliptic arcs. The 'land agent' was the English amateur, John Landen (1719–90) who was in the service of Earl Fitzwilliam from 1762 until 1788. His name is familiar in 'Landen's transformation' for an elliptic integral.

The tale uniting these two was their work on rectifying elliptic arcs and manipulating the corresponding integrals. In 1691, Bernoulli had discovered that it is possible to find arcs of a parabolic spiral which are of equal length but are not congruent. Fagnano obtained similar results for the lemniscate, and enunciated the general theorem that if m is an integer, a quadrant of the lemniscate can be divided into 2^m or 3×2^m or 5×2^m equal parts. Amongst his results occur rudimentary forms of the addition theorems for elliptic functions. Many years later, Jacobi referred to the day on which a copy of Fagnano's works reached Euler as "the birthday of elliptic functions". Landen, in his "Mathematical Lucubrations" (1755) studied transformations of integrals, showing considerable ingenuity in obtaining forms convenient for calculation. This aspect was developed later by Legendre, Gauss and Ivory. Prof. Watson mentioned, in passing, that, in his opinion, mathematicians of the eighteenth century handled the technique of the calculus more skilfully than the technique of analytical geometry.

After this pioneer work, development took place on two very different lines. Legendre developed the elaborate, but unfruitful calculus of integrating expressions giving elliptic arcs, whilst thirty years later Abel and Jacobi developed the vastly more important concept of inverting such integrals, thus founding the theory of doubly periodic functions. One of time's revenges lies here. The first mention of this concept of inversion is in a manuscript by Gauss dated January 8, 1797. Had Legendre known of this, he would never have given the last part of his life to the futile labour of his "Traité des fonctions elliptiques". Yet Gauss's failure to announce his result was directly due to his treatment at the hands of French mathematicians when his memoir on arithmetical numbers was refused publication by the French Academy. After their humiliating refusal to publish this work, Gauss was loath to take any steps to publish during his own lifetime.

Prof. Watson mentioned some recent approximate formulæ for the perimeter of an ellipse, due to Peano (1887)—a mathematician usually associated with very different studies—and Ramanujan (1914). In connexion with his address an unusually complete exhibition of books on elliptic functions, arranged chronologically, had been compiled by Prof. Neville.

The discussion on "The Study of Statistics in a School Course" was opened by Mr. F. Sandon, headmaster of Plymouth Grammar School, who presented the unpopular view that the subject could have no place in the normal course. He suggested that the capabilities of pupils are so various and the intrinsic difficulties of the subject so real that little value would result. Few teachers appear to know much of the subject. Statistical principles can be applied to modify some topics in the arithmetic course, such as the teaching of averages and graphs of statistics, but work beyond this, such as probability or correlation, is too difficult or laborious. Mr. Tuckey of Charterhouse and Mr. Wright of Winchester gave evidence flatly contradicting this. With an average middle school form, a course of two hours a week has proved possible and profitable at Charterhouse. Frequency curves, probability, dispersion and correlation have been studied with some seriousness. At Winchester, rather abler boys with no examination in prospect have covered a systematic textbook course as far as Spearman's "Foot-Rule" for measuring correlation. The balance of opinion of the meeting appeared to favour testing these opinions as to the possibility of teaching statistics in schools.

Other papers discussed various topics. Dr. Smart of Cambridge traced the history and importance of the precession of the equinoxes. Dealing with the importance of accuracy in observation, he mentioned the recent discovery of the work of the Rev. John Hornsby, an eighteenth century Oxford astronomer. From Hornsby's observations it is possible to obtain the data showing the motion of the perihelion of Mercury—a phenomenon that was not satisfactorily explained until the present century. Work in school was dealt with by several teachers. Mr. Boon of Dulwich pleaded for more use of side-tracks such as history and puzzles in elementary mathematics. Mr. Robson of Marlborough showed the possibilities of parametric representation in the specialist course. A keen discussion followed Mr. Siddons's paper on "Learning Theorems in Geometry". Mr. Siddons suggested that learning theorems is not valuable until pupils have some skill in solving riders. Mr. Piggott of Dartmouth put forward a more real method of teaching relative velocity than that current in textbooks. The device of 'reversing a velocity' was shown to be quite unnecessary. Finally, the Rev. D. B. Eperson of Sherborne concluded a most successful meeting with a diverting account of Lewis Carroll's work as mathematician.

Annual Conference of the Geographical Association

THE annual conference of the Geographical Association was held at the London School of Economics on January 4–6, and at the Imperial Institute, South Kensington, on January 7. About five hundred members took part, provincial and Scottish branches being particularly well represented.

The retiring president, Dr. H. R. Mill, chose as the title for his presidential address "An Approach to Geography". In fluent and easy language, yet with a precision too often absent from generalisations, he traced the progress of the modern concept of scientific geography. He emphasised the steady conquest by man of so many of the natural factors of his environment and the evolution of the world of to-day, which may thus be free and open to the movements of mankind. But man, in conquering the natural barriers, has erected in their stead artificial barriers in the form of frontiers with their tariff walls and innumerable other restrictions. Thus the geographer cannot ignore the new, though artificial, factors of the environment and his work must interlock with that of the economist. At the same time, the problem is complicated by the fact that geographical factors are becoming more and more important in that, with the world improvement of transport and communications, it no longer pays a country to attempt the production of a commodity for which it is geographically unsuited.

This function of the geographer in helping to provide solutions for the complicated problems of the present day was further emphasised by Sir John Russell in his lecture on "Modern Changes in the Sources of our Food Supplies". One of the speakers at the annual dinner referred to geography as the 'most human' of all the sciences and to the appropriateness of meeting in the School of Economics, which was represented at the dinner by its director, Sir William Beveridge. The benefits to be derived from collaboration with allied sciences was further emphasised by a joint meeting with the Le Play Society, when an account of studies in Yugoslavia —the result of party visits led by himself and Dr. L. D. Stamp—was given by Mr. Arthur Davies.

The Association extended its welcome to Col.

Kenneth Mason, recently appointed professor of geography in the University of Oxford, who lectured on the exploration of the Himalaya, and to Lord Meston, whose first-hand account of contrasts in the Ganges basin threw many delightful sidelights on Indian geography.

The revival of interest in the land of Britain and its uses must inevitably be a feature of the next few years and the Association was given an account of the work of the Welsh Plant Breeding Station, Aberystwyth, in Prof. R. G. Stapledon's lecture on the improvement of hill grazings. A brief account was given of the progress also of the Land Utilisation Survey, now nearing completion.

Amongst the many meetings arranged for teachers, special interest was attached to the discussion of a model First Certificate examination paper drawn up by the Standing Committee of Secondary School Teachers. No new features not already commonly used in this examination were found suitable for inclusion, and suggestions made by some teachers present were nearly all negatived by others. Though taking little part in the discussion, a number of examiners were present and were doubtless relieved to find the meeting expressing the opinion that papers actually set by various examining bodies in recent years compare very favourably with the paper suggested by the Committee. Many teachers were clearly brought to realise the extreme difficulty of setting a paper to be answered by ten thousand candidates prepared by a thousand different teachers.

L. DUDLEY STAMP.

Calendar of Nature Topics

St. Hilary's Day. The depth of winter

January 14.—Although in the northern hemisphere the shortest day and least amount of insolation occur about December 21, the temperature of the air is maintained by the heat stored in earth and sea, and as this heat is given up, the average temperature continues to fall for nearly a month after the shortest day. This is expressed in the proverb:

"As the day lengthens,
So the cold strengthens."

The turn of the season is associated with St. Hilary's day in England and with St. Maur's day (January 15) in France. According to the smoothed ninety year averages at Greenwich, the coldest days of the year are January 12–14, all of which have the same mean temperature. The vagaries of our climate are, however, so great that in any one year the coldest day may fall on any date from mid-November to mid-March.

Winter Congregations of Birds

During January, Gilbert White noted the congregating of several species of British birds—in the order of their observation, skylarks, snow-buntings and chaffinches. He might have added, as equally characteristic of the season, fieldfares, redwings and mistle-thrushes, for the flocking together of the individuals of a species during the off-season when sex is at its lowest is a common occurrence. Of all the congregations, those of the chaffinch intrigued him most, first because the vast flocks which he saw contained many more birds than could be hatched in one neighbourhood, and secondly because the flocks seemed to be almost all hens. On the latter point he had been misled to some extent by Linnæus, who, thinking that "before winter all the hen chaffinches migrate through Holland into Italy", leaving the cocks behind, named the species *Fringilla cœlebs*. Although there is no such independent migration, it is true that there is a tendency for chaffinches to group in flocks in which one sex predominates, but equally mixed flocks are common enough. As regards the excessive numbers in the winter flocks, the explanation is that while we retain our native stock—for our British-bred birds do not seem to migrate—there are added to their numbers, immigrants from northern and central Europe which remain in Britain from about November until May, and birds of passage which make a temporary sojourn in Great Britain during their progress towards, and return from, south-western Europe.

Movements of Winter Flocks of Birds

It is generally stated that the winter flocks of chaffinches in Britain are nomadic, wandering from one area to another in search of food, and although it is certain that such as the great immigrant flocks of wood-pigeons move over the country from one feeding ground to another as food supplies become exhausted, an American experiment suggests that more has to be learned about the detailed movement of the winter congregations. Crowned sparrows (*Zonotrichia*), on their winter migration, arrive in late September on the campus at Stanford University, California, and leave on their northward migration in late April or early May. A combination of ringing, trapping, and staining the feathers with a distinctive oil colour dissolved in carbon tetrachloride, so that the members of a particular flock could be recognised in the field, led to some interesting results (John B. Price, *Condor*, 1931, p. 238). In the first place, individual birds, after their summer migration to the breeding quarters, which range from British Columbia to Alaska, frequently return to winter in the same district and are usually recaptured even in the same trap. In the winter of 1927–28, 197 golden-crowned sparrows (*Z. coronata*) were ringed at Stanford, and in the following winter after a lengthy migration 28 per cent were re-captured there, and many more may have returned which were not trapped. In 1928–29, 120 golden-crowns were re-captured which had been captured (ringed or recovered) at Stanford the previous year. Of these, 96 were taken by the original trap and only 24 were re-captured exclusively at other traps, although the traps were quite close together. Here is an indication not only of a fine sense of locality, but also of a certain flock association which remains constant in successive winters in spite of the intervening break-up of the breeding season.

A second remarkable discovery, revealed by the trapping of ringed birds and confirmed by the movements of artificially coloured birds, a standard colour having been adopted for each flock, was that there was practically no interchange of individuals between flocks. Although the two traps concerned with two distinct flocks were but 100 yards apart, only one case of the crossing over of an individual occurred. Further, none of the stained golden-crowned sparrows was seen 600 yards from the staining trap and most were observed within 400 yards of it. It would seem that if territory dominates the breeding *pair* during spring and summer, it dominates the *flock* and not the individual during the winter, to such a degree that each definite flock has its own almost exclusive range of about 15–20 acres.

Societies and Academies

London

Geological Society, Dec. 7. J. A. Douglas: Geology of the Marcapata valley in Eastern Peru. The broad zone of Devonian rocks which runs north from Juliaca forms the bulk of the cordillera of Vilcanota, and there is little evidence of the existence of Upper Carboniferous deposits, which cover so wide an area in the region around Lake Titicaca. An underlying unfossiliferous black shale series, probably of Silurian age, is the chief formation in the cordillera of Carabaya. The intermontane region presents a vast accumulation of glacial debris, derived from the now shrunken glaciers of the Vilcanota knot, a group of giant snow-covered peaks which, from the evidence of morainic material, must be largely of volcanic origin. The eastern flanks of the range disclose a great diversity of metamorphic rocks, chiefly andalusite and cordierite-hornfels, penetrated by intrusions of typically alkaline biotite-microcline-granite; while at the head of the Marcapata Valley occurs an interesting suite of coarse-grained, basic, hornblende rocks, probably of hybrid origin, with associated pegmatites. Farther down the river, dynamically metamorphosed rocks are encountered chiefly granitoid gneisses and amphibolites, with associated paragneisses of sedimentary origin. L. R. Cox: Fossiliferous siliceous boulders from the Anglo-Egyptian Sudan. The paper describes a series of scattered eroded boulders of a hard, splintery, fossiliferous, chert-like siliceous rock found at two localities in the Berber district of the Anglo-Egyptian Sudan. Many of the boulders consist of rounded or subangular grains of opal or opal-derived chalcedony of various sizes with clear quartz and chalcedony in the interstices between them. On account of their large content of opaline silica it is considered that they are a product of secondary and probably surface silicification, and have been formed from, and within, a deposit once spread over the district. Except for one puzzling specimen which may be a fragment of a *Pinna* shell (a marine lamellibranch) and some obscure remains, apparently of plants, the fossils enclosed in the boulders are all non-marine gastropods. A Lower Tertiary age can be assigned with confidence to the fauna, on account of the presence of the genus *Pseudoceratodes*; the precise age may be Upper Eocene or possibly Lower Oligocene.

Paris

Academy of Sciences, Nov. 21. Ch. Lallemand: The world crisis and the gold standard. The author suggests the gram of gold as an international monetary standard, in which all financial contracts should be expressed. A. Cotton: Remarks on a note of M. Schérer on circular magnetic dichroism and magnetic rotatory dispersion. The author had earlier made experiments similar to those recently described by Schérer, but as the magnetic fields were only about one tenth those used by Schérer, no certain proof of circular magnetic dichroism could be obtained. The history of the subject is reviewed and discussed. Georges Claude: The manufacture of commercial oxygen. A description of recent progress in the preparation of oxygen by the fractional distillation of liquid air, especially the improvements introduced by Frankl. J. Schokalsky: The circumnavigation of the François Joseph archipelago by the north. An account of a voyage around this archipelago in a small vessel, the *Knipovitch* (motor 125 h.p.) under Capt. S. Popov. The author's view of an improvement in the polar climate, possibly temporary, was confirmed. Lucien Daniel: The variations of *Helianthus Dangeardi* at the fifth generation. Bertrand Gambier: The congruence of circles: focal points and focal surfaces. Lucien Chamard: Certain singular points of ensembles equidistant from a point ensemble. Marcel Brelot: The trend of sub-harmonic functions in the neighbourhood of a point, singular or not. Arnaud Denjoy: The characteristics of the tore. Jacques Devisme: Some applications of hypergeometric functions. G. Bourion: A class of Taylor's series. Robert L'Hermite: Plane rectangular pieces of small thickness submitted to peripheral pressures situated in their plane. Bernard Lyot: The direct observation of solar prominences at Meudon. The direct method of observing the prominences has advantages over the spectrohelioscope or spectroheliograph, but up to the present has only been used during eclipses. The possibility of directly observing the protuberances was proved by observations made on the Pic du Midi in 1930 and 1931. By a careful study of suitable screens it has now been found possible to make good observations at the Meudon Observatory. An exposure of one second gives a good solar image (8 cm. diameter) as against several minutes required by the spectroheliograph. Hence by means of kinematograph films it is now possible to study the complex movements of prominences. Y. Rocard: The formation of negative ions according to quantum mechanics. I. I. Agarbiceanu: The absorption of the fluorescent light of iodine by the same vapour. M. Scherer: The circular magnetic dichroism and abnormal magnetic rotatory dispersion of solutions of cobalt chloride. Curves are given showing the ellipticities and rotations as functions of the wave-length. The large Bellevue electromagnet was used to obtain the magnetic fields. P. Jacquet: Study of the strains in electrolytic copper deposited in the presence of colloids. In a previous communication on the same subject the colloid used was gelatine: the present note describes similar experiments carried out with other colloids, serum albumin, gum arabic, gum tragacanth and dextrin. The results are summarised in graphs. H. Forestier: The influence of the magnetic field on the electrolysis of nickel salts. The rate of deposit of nickel by electrolysis in acid solutions diminishes as the strength of the magnetic field increases: in solutions of zinc or copper the magnetic field causes a slight increase in the velocity of deposit of the metal, due possibly to the influence of the convection currents of the electrolyte. Picon: Thorium sulphide. This sulphide can be prepared by heating the oxide, placed in a graphite boat, in a current of hydrogen sulphide at 1200° C. The reaction is complete after one hour, and the temperature is then raised to 1600° for thirty minutes. The product is thus melted and is free from oxygen and carbon. The physical and chemical properties of the thorium sulphide are given. Mme. Ramart-Lucas and Mme. M. Grumez: The colour and structure of oximes and semicarbazones. The absorption in the ultra-violet of oximes and semicarbazones shows that not only can these substances exist in two stereochemical forms, but also in two isomeric forms in which the functional group is different. Charles Dufraisse and Raymond Buret: Researches on the dissociable organic oxides. Extension of the methods for the preparation of the rubrenes. Application to the synthesis of a dichlordiphenylrebene, $C_{30}H_{18}Cl_2$. The practical preparation of this substance starting from dibenzoylmethane. S. Goldsztaub: The crystalline structure of gœthite. Jacques Fromaget: New observations on the geology of the stanniferous region of Nam Pha Thène (Laos). P. Geoffroy: The probable age of the Doui series in the Middle Chélif (Algeria). Ch. Joyeux, J. G. Baer, and J. Timon-David: Researches on the evolutive cycle of the trematodes belonging to the genus *Brachylæmus*. Henri Jean Frossard: The measurement of the ventricular pressure by the pulsatory method. Georges Bourguignon and Socrate Eliopoulos: The classification of different ions in natural chemical families by their vaso-motor action in trans-cerebral dielectrolysis. P. Kucharski: Researches on the structure of the vowels. A. Girard, G. Sandulesco, A. Fridenson, and J. J. Rutgers: A new crystallised sex hormone. A new hormone, equilenine, has been isolated from the urine of pregnant mares. 1·5 gm. of the purified hormone were obtained from 52 tons of urine. It is a ketone of the composition $C_{18}H_{18}O_2$.

MELBOURNE

Royal Society of Victoria, Oct. 13. C. Oke: Australian Staphylinidæ. Alan Coulson: Diabase rocks at the You Yangs near Geelong. Boulders of diabase are recorded from this locality; when examined microscopically they show uralitisation of a similar character to that of the epidiorite at Ceres and Dog Rocks; it is probably of Cambrian (Heathcotian) age. The occurrence lies in an axial line passing through the Colbinabbin Range, Mount William and Ceres. Alan Coulson: The older volcanic and Tertiary marine series at Curlewis near Geelong. This series of basalts and tuffs underlies Tertiary marine clays and limestones of a probable Janjukian age. Faulting and folding have affected the area and are illustrated in plans and sections of the beach and cliffs at Curlewis. Cause of earth movements not apparent, but are tentatively correlated with the (?) newer Pliocene tectonics of the Geelong district. W. M. Holmes: The Mornington earth tremor of Sept. 3, 1932. The brief duration of this earth tremor did not permit the identification on the seismogram of the various phases of the earth waves with any degree of accuracy. The epicentre was therefore determined by two hundred replies received from a questionnaire prepared on a basis of the modified Mercalli scale of intensities. A numerical value was assigned to each locality, and lines and bounding areas of equal intensity were drawn on the map. These lines indicated an epicentre at 38° 15′ S. and 145° E., a position west of Mornington in Port Philip Bay.

ROME

Royal National Academy of the Lincei: Communications received during the vacation. G. A. Crocco: The stability of 'instrumental' flight. The problem of the stability of an aeroplane in 'blind' flight may be defined by three equations treating of the perturbed motion of the baricentre, and by three 'instrumental' equations controlling the perturbed motion about the baricentre. G. Armellini: Some theorems on the problem of two bodies of decreasing masses. Q. Majorana: A new photoelectric experiment. When exposed to the action of an intense pulsating radiation, very thin sheet metal undergoes an appreciable increase in its electrical resistance which does not appear to be due solely to the thermal action of the light. The results of experiments with silver thin enough to show a distinct blueish transparency indicate that, under the conditions mentioned, the resistance of the metal is subject to pulsation, the mean value being somewhat greater than that observed in the absence of the light. T. Boggio: The curvature of lines of varieties. Various relationships—some of them not previously observed—between the curvature and torsion of a geodetic and the curvature of one of its plane projections, are deduced. H. Chapiro: The transplantation of the parallel transport. L. Laboccetta: The effective integration of discontinuous functions (2): *Reduction to normal types and fundamental integrals.* All ordinary discontinuous functions may be reduced, without altering the value of their integrals, to certain fundamental types which admit of easy integration. G. Lampariello: The equation of the transverse vibrations of an elastic rod supported at its ends. W. S. Urbanski: The integration of Hamilton's equations for infinite time. V. Hlavaty: Differential projective invariants of a curve in the projective space P_{n-1} ($n =$ or > 3). B. Segre: The conditions for the regularity of a linear system of forms. M. Cimino: The laws of the areas of an Einsteinian motion considered in ordinary Euclidean space. G. Agamennone: The supposed repercussion, at the antipodes, of the eruption of Krakatoa in 1883. R. Einaudi: Magnetic behaviour of the oxygen molecule. The magnetic behaviour of the oxygen molecule in fields of the order of magnitude of 10^4 gauss is studied theoretically, and the results of experiments by Schnurmann on magnetic deviation are found to be justified on theoretical grounds. P. Straneo: The unitary theory and absolute geometrisation. G. C. Wick: The motion of an electron in a crystalline lattice. Taking into account the resonance forces due to the identity between a conducting electron and the bound electrons of the lattice, the energy levels of an electron in a lattice are calculated as a first approximation. A relative maximum of the energy for zero velocity of the electron is revealed. C. Antoniani and F. Zanelli: Investigations on the cholesterol of the human brain. The molecular magnitude and the percentage composition of human cerebral cholesterol are the same as those of biliary cholesterol. Whether obtained from the fœtus or from the adult, the cholesterol of the brain and certain of its derivatives exhibit slightly higher melting points than the product from the bile, and similar differences are observed in the specific rotation. These results are not, however, regarded as evidence of the non-identity of the two cholesterols. A. Baroni: Lithium alloys. (1) Thermal and X-ray analysis of the system lithium-tin. The diagram of state derived from the thermal analysis indicates the existence of the three compounds, Li_4Sn (M.P. 684°), Li_2Sn_5 (M.P. 483°) and $LiSn_4$, and of three eutectic points at 458°, 320°, and 214°, corresponding respectively with 35, 58, and 94 per cent (atomic) of tin. The X-ray analysis permits of the identification of the compounds $LiSn_4$ and Li_2Sn_5, but the photograms obtained by the powder method do not allow the structures of these compounds to be calculated. F. Scarsella: The diffusion of the strata with *Posidonomya alpina* in the Central Appennines. A. Cavinato: Thermal expansion in crystals and Haüy's law. The validity of Haüy's law for a crystal expanded by heat is demonstrated. B. Monterosso: Cirrepedological studies (9). Anærobiosis in *Chthamalus stellatus* Ranzani. Gabriella Pastega: Power of recovery and growth of the cyclopean eyes of 'lithium' embryos of *Rana esculenta*.

Forthcoming Events

Monday, Jan. 16

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Dr. L. J. Spencer: "Meteorite Craters as Topographical Features of the Earth's Surface".

KING'S COLLEGE, LONDON, at 5.—Prof. G. Temple: "The Principle of the Quantum Theory".

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. L. E. Bayliss: "The Respiratory Functions of the Blood" (succeeding lectures on Jan. 20, 23 and 27).

Tuesday, Jan. 17

ROYAL INSTITUTION, at 5.15.—Prof. J. C. McLennan: "Low Temperatures and Low Temperature Phenomena" (succeeding lectures on Jan. 24, 31, and Feb. 7).

Wednesday, Jan. 18

UNIVERSITY COLLEGE, LONDON, at 5.30.—H. M. Adams: "Bibliography in Cataloguing".

ROYAL SOCIETY OF ARTS, at 8.—Olaf F. Bloch: "Recent Developments in Infra-Red Photography".

ROYAL MICROSCOPICAL SOCIETY, at 5.30.—(Annual General Meeting). Mr. Conrad Beck (Presidential Address): "Microscope Illumination with Transmitted Light".

ROYAL METEOROLOGICAL SOCIETY, at 7.40.—(Annual General Meeting). Prof. S. Chapman (Presidential Address): "Atoms, Molecules and the Atmosphere".

Thursday, Jan. 19

ROYAL INSTITUTION, at 5.15.—Prof. J. B. S. Haldane: "Recent Advances in Genetics" (succeeding lectures on Jan. 26, Feb. 2 and 9).

Friday, Jan. 20

ROYAL INSTITUTION, at 9.—Sir William Bragg: "The Crystals of the Living Body".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. W. W. Gregg: "The Descent of Manuscripts" (succeeding lecture on Jan. 27).

UNIVERSITY OF LONDON (at University College Hospital Medical School, University Street, Gower Street, W.C.2), at 5.15.—Prof. Max Bergmann: "The Chemistry of Proteins" (succeeding lectures on Jan. 23 and 24).

Official Publications Received

GREAT BRITAIN AND IRELAND

British Industries Fair, 1933. Olympia and White City, London, February 20th to March 3rd. Organised by the Department of Overseas Trade. Special Overseas Advance edition. Pp. xvi + Ad. xvi + 504 + Ad. 164. (London: Department of Overseas Trade.) 1*s*.

Royal Society of Medicine. Report of the Committee appointed by the Section of Otology for the Consideration of Hearing Tests. Pp. 33. (London: Longmans, Green and Co., Ltd.) 2*s*. 6*d*.

Proceedings of the Geologists' Association. Edited by G. S. Sweeting. Vol. 43, Part 4. Pp. 277–372 + plates 16–22. (London: Edward Stanford, Ltd.) 5*s*.

Forestry Commission. Report on Census of Production of Home-Grown Timber, 1930. Pp. 13. (London: H.M. Stationery Office.) 3*d*. net.

Two Lectures on The Nature of Simple Molecules and of Elementary Processes. By A. J. Allmand. Pp. 57. (London: Institute of Chemistry.)

Torquay Natural History Society. Transactions and Proceedings for the Year 1931–32. Vol. 6, Part 2. Pp. 83–172. (Torquay.)

Leeds University. Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing during the Session 1931–32. Pp. 16. (Leeds.)

Birmingham Bureau of Research on Russian Economic Conditions. Memorandum No. 8: The Communist Policy towards the Peasant and the Food Crisis in the U.S.S.R. Pp. 24. (Birmingham: The University.)

Journal of the Chemical Society. December. Pp. iv + 2809–2999 + viii. (London: Chemical Society.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 5 (N.S.), No. 11, November. Abstracts Nos. 1952–2168. Pp. 363–398. (London: H.M. Stationery Office.) 1*s*. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 28: The Anatomy of the Tortoise. By Dr. J. Stuart Thomson. Pp. 359–461 + plates 19–43. 8*s*. Vol. 20 (N.S.), No. 29: Effect of the Conditions of Storage on the Vitamin D Potency and on other Features of Codliver Oil. By E. J. Sheehy. Pp. 463–468. 6*d*. Vol. 20 (N.S.), No. 31: On the Colloidal Calcium Phosphate of Milk. By G. T. Pyne and J. J. Ryan. Pp. 471–476. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

OTHER COUNTRIES

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Mémoire No. 52: La faune de l'Assise de Winenne (Emsien Moyen) sur les bordures méridionale et orientale de bassin de Dinant. By Eug. Maillieux. Pp. 102 + 5 plates. Hors série: Résultats scientifiques du Voyage aux Indes orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. Publiés par V. Van Straelen. Vol. 2, Fasc. 11: Alcyonaria. By Miss L. M. I. Dean. Pp. 24 + 4 plates. Vol. 2, Fasc. 12: Madreporaria, Zugleich ein Versuch einer vergleichenden Ökologie der gefundenen Formen. By M. E. Thiel. Pp. 177 + 21 plates. Vol. 3, Fasc. 12: Myriopoden. By C. Attems. Pp. 34 + 6 plates. Vol. 4, Fasc. 3: Heterometabola II. 1: Odonata, by F. C. Fraser; 2: Orthoptera—Acrididæ, by C. Willemse. Pp. 55 + 1 plate. Vol. 6, Fasc. 1: Algues. By Mme. Dr. A. Weber-Van Bosse. Pp. 27 + 5 plates. (Bruxelles.)

India: Meteorological Department. Scientific Notes, Vol. 5, No. 4: Tables extending Walker's Criteria and for finding the Chance of Success of a Forecast. By Dr. S. R. Savur and S. Gopal Rao. Pp. 31–39. (Calcutta: Government of India Central Publication Branch.) 6 annas; 8*d*.

U.S. Department of Commerce: Coast and Geodetic Survey. Serial No. 552: Annual Report of the Director of the Coast and Geodetic Survey to the Secretary of Commerce for the Fiscal Year ended June 30, 1932. Pp. iii + 32. (Washington, D.C.: Government Printing Office.)

U.S. Geographic Board. First Report on Foreign Geographic Names, 1932. Pp. v + 113. (Washington, D.C.: Government Printing Office.) 10 cents.

Instituto Geográfico, Catastral y de Estadística. Anuario del Observatorio Astronómico de Madrid para 1933. Pp. 308. (Madrid.)

Transactions and Proceedings of the New Zealand Institute. Vol. 63, Part 1, October. Pp. xli + 79. (Dunedin.)

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 15: Examination of a proposed Relationship between the Lea Test and the Single Thread Test Results. By V. Venkataraman and Dr. Nazir Ahmad. Pp. 11. (Bombay.) 8 annas.

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 1: Malayan Agricultural Statistics, 1931. By D. H. Grist. Pp. iv + 48. (Kuala Lumpur.) 50 cents.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No 67: Methods for the Identification of the Coloured Woods of the Genus Eucalyptus. By H. E. Dadswell and Maisie Burnell. (Division of Forest Products, Technical Paper No. 5.) Pp. 50 + 34 plates. Bulletin No. 69: An Investigation of the Taxonomic and Agricultural Characters of the Danthonia Group. By A. B. Cashmore. Pp. 22 + 1 plate. Pamphlet No. 33: Enzootic Hæmaturia (Hæmaturia Vesicalis) of Cattle in South Australia. By Dr. L. B. Bull, C. G. Dickinson and A. T. Dann. Pp. 24. (Melbourne: H. J. Green.)

Reports of the Newfoundland Fishery Research Commission. Vol. 1, No. 4: Annual Report, Year 1931. Pp. 110 + 6 plates. (St. John's.) 1 dollar.

Canada: Department of Mines: Mines Branch. Feldspar. By Hugh S. Spence. (No. 731.) Pp. vii + 145 + 13 plates. (Ottawa: F. A. Acland.) 25 cents.

Proceedings of the Imperial Academy. Vol. 8, No. 8, October. Pp. xxi–xxiii + 331–405. (Tokyo.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 15, No. 3. Pp. ii + 169–197 + plates 11–13. (Tôkyô and Sendai: Maruzen Co., Ltd.)

Spisy vydávané přírodovědeckou Fakultou Masarykovy University (Publications de la Faculté des Sciences de l'Université Masaryk). Čís. 153: Měření gravitační konstanty točivými vážkami (Mesure de la constante de gravitation par la balance de torsion). By Josef Zahradníček. Pp. 30. Čís. 154: O dispersi v teorii Markovových řetězů (Sur la dispersion dans la théorie des chaînes de Markoff). By Jan Potoček. Pp. 28. Čís. 155: Cristobalit ze serpentinů ze západní Moravy (Cristobalit aus westmährischen Serpentinen). By Jiří Novák. Pp. 10. Čís. 156: Sur une équation fonctionnelle de la théorie des probabilités. By B. Hostinský. Pp. 36. Čís. 157: Beryllnaté soli paraderivátů benzensulfonové kyseliny a jejich hydrolysa (Beryllium Salts of the Paraderivatives of the Benzenesulphonic Acid and their Hydrolysis). By V. Čupr and J. Širůček. Pp. 28. Čís. 158: Buzení Hertzových vln diodami (Emission des ondes Hertziennes par des diodes). By J. Šahánek. Pp. 20. (Brno: A. Píša.)

Sborník vysoké Školy Zemědělské v Brně (Bulletin de l'Institut National Agronomique, Brno). Čís. 25: Vliv úpravy krmné dávky na produkci mléka se zřetelem na kvalitativní vlastnosti živin krmiva (The Influence of the Adjusted Ration in relation to Qualities of Nutrients on Milk Production). By Dr. Jaroslav Herzig. Pp. 55. D.19: Pokus o prozkum periodické proměny lesního a lučního stanoviště (Essai des recherches du changement périodique de la station forestière et de celle des prairies). By Dr. Alois Zlatník and Dr. Ivan Zvorykin. Pp. 129 + 26 plates. (Brno: A. Píša.)

Práce Moravské Přírodovědecké Společnosti, Brno. Svazek 6, Spis 47–52, 1930–1931. Pp. iii + 242. 60 Kč. Svazek 7, Spis 53–64, 1932. Pp. iii + 420. 80 Kč. (Brno: A. Píša.)

CATALOGUES, ETC.

The *Chemist and Druggist* Diary, 1933. (Sixty-fifth Year of Publication.) Pp. 446 + Diary. (London: The *Chemist and Druggist*.)

Hercules Cycles. Pp. 16. (Birmingham and London: The Hercules Cycle and Motor Co., Ltd.)

Catalogue of B.D.H. Fine Chemical Products. (January, 1933.) Pp. 152. (London: The British Drug Houses, Ltd.)

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The Arts in Industry

THE view that mass production necessarily tends to a mechanisation of industry and society, although stoutly challenged by such leaders of industry as Mr. Henry Ford and Mr. E. A. Filene, finds sufficient support to emphasise the importance of recent surveys of the position of industrial art in Great Britain. Indeed the fact that Mr. Ford and Mr. Filene base much of their argument on the opportunity afforded by increased leisure for developing the arts to some extent accentuates the importance of a critical examination of the position of art in relation to industry, and necessitates some effort to determine whether or not under modern industrial conditions mass production involves so little intelligence or craftsmanship in its processes that the outcome is the staffing of industry mainly by cheap people of low intelligence. If, indeed, such is the necessary consequence of power production, the mechanisation of society may be too high a price to pay for the advantages which mass production confers. Ruskin's picture of the industrialisation of England has to-day an application and a validity which is far from being confined to the significance which he first attached to it: "Unless you provide some elements of beauty for your workmen to be surrounded by, you will find that no elements of beauty can be invented by them."

It would be unfair to charge modern industry, in spite of mass production, with indifference to æsthetic considerations. Attention has already been directed to the relations of art and industry in the important reports issued in recent years by the Balfour Committee on Industry and Trade. In "Factors in Industrial and Commercial Efficiency" the Committee points out that the difficult problems of art and design which have emerged from the disturbing and sometimes disastrous effect of mechanisation, with its sub-division of employment and mass production, on industrial art by breaking up the old craft traditions, revolutionising technique and severing or weakening the close relations which previously existed between designer and executant, have scarcely yet been fully faced. Since success in international competition depends more and more on quality of output, an adequate solution of these problems is of critical importance to the position of British trade.

A survey of the present position of British industries in respect of industrial art contributed to the same report by the British Institute of Industrial Art stresses the opinion that modern tendencies in certain trades to sever design from manufacture and to rely unduly on foreign sources for the former involve serious danger to the well-being of British industries and art. The survey was limited to the position of industrial art in relation to productive industry, but the growing gap in modern industry between the original producer and the ultimate consumer makes its position in relation to the distributive trades likewise of crucial importance. The final report of the Committee on Industry and Trade similarly confined its observations mainly to productive industry, expressing the opinion that the situation was far from satisfactory in view of the vital importance of fine design and workmanship in maintaining and enhancing the reputation and attractiveness of many classes of British products.

A good deal of similar evidence was in existence on the relations of art and industry when in July 1931 a Committee was appointed by the Board of Trade under the chairmanship of Lord Gorell on the production and exhibition of articles of good design and every-day use. The report of this Committee was published in March 1932 but its excellent recommendations are still awaiting action, and this hiatus appears to be partly responsible for prompting a recent suggestion by Mr. J. A. Milne, in his inaugural address to the Royal Society of Arts on beauty in industry, for the establishment of a ministry of fine arts. Mr. Milne urged that reasons of economy have weakened all the recent tentative Government efforts to deal with this important subject and that, without effective financial backing such as a ministry of arts could supply, there was little prospect of improvement.

The terms of reference of the Gorell Committee, like the pleadings of Mr. Milne, recall the arguments of John Ruskin, one of the pioneers of the movement in the latter part of the nineteenth century to foster healthier relations between creative design and craftsmanship, and in particular his assertions that the wisdom of art consists in its unselfish devotion to the service of men, and that art does its duty "in completing the comforts and refining the pleasures of daily occurrence and familiar service". The chief recommendations of the Committee are indeed concerned with the promotion of exhibitions of industrial art organised to improve the taste of designers, manufacturers, distributors and the general public by the display to the best advantage of beautiful modern manufactured goods, due regard being paid to the purchasing power of the householder of moderate means. The establishment of a central body with executive powers, responsible for such exhibitions and in close association with the Department of Overseas Trade, the enlistment of the support of local art museums, and the co-ordination of the activities of the British Institute of Industrial Art with those of the new national organisation, are all recommendations directed to this end.

The above proposals are perhaps those which are most likely to involve direct expenditure and which Mr. Milne had chiefly in mind in his appeal for a ministry of fine arts. No less significant, however, than a new exhibition policy are other concurrent measures of general policy advocated by the Committee. Prominent among these is the initiation of steps to terminate the divorce of 'fine' and 'industrial' art and "to secure that numbers of the leading and most promising artists and craftsmen of the day should be encouraged to turn their energies into the industrial manufacturing field and that they find there as secure, remunerative and honoured a career as in painting and sculpture". The report continues in words which will have a familiar ring to scientific workers: "Unless first rate industrial work by artists receive national recognition in future to the same extent as the best work in the field of painting and sculpture many of the best artists will continue to avoid an industrial career".

Closely related is the question of the improvement of art education of the country, itself, which is one aspect of the general problem of improved and closer relations between education and industry and as such falls within the purview of inquiries recommended to be undertaken through the British Institute of Industrial Art. It is clear that much remains to be done in order that teachers and students in art schools should have a clear conception of the requirements of industry, and industrialists a first-hand knowledge of these schools.

While, however, these measures should help to promote the supply of competent designers and artists, the question of demand must not be overlooked. The supply is unlikely to be adequate in either quality or quantity unless the demand for such services is sufficiently widespread and the appreciation awarded them sufficiently generous either in remuneration or status. From this point of view it is essential that the nation should, as urged by the Gorell Committee, face, in the public, secondary and elementary schools the problem of making the understanding and enjoyment of beautiful things an essential part of the day-to-day life of the school. It is only from the vision and training thus imparted that we can expect either in leisure or working hours a general level of artistic judgment and appreciation sufficient to resist any untoward effects of mass production.

It is indeed here that we touch on the fundamental problem which even in the Gorell report scarcely receives expression. Valuable as are the results already attending what is generally known as the 'arts and crafts movement', in the main the products of this movement have scarcely been within the regular purchasing power of consumers of moderate means. The movement has largely been concerned with the encouragement of handicraft and has not penetrated the processes of modern industry. A reversion to handicraft could not solve the problem of beautifying articles of common use within the purchasing power of the ordinary consumers and the technique of handicraft differs fundamentally from that of industrial manufactures. It is this field which has now to be captured for art. We have to face the task of expressing beauty in the materials and products and processes of modern industry even under the conditions of mass production. The production of goods in quantity is not necessarily a bar to the production of articles intrinsically beautiful. Mass produced goods commonly lack artistic merit because insufficient attention has been devoted to the design, to the materials of which the product is made or the purposes to which it is to be put—in a word, because the manufacturer has been concerned more with imitating the past than discovering new methods of artistic expression for his new powers and materials.

The reports to which we have directed attention pose fundamental problems which even in days of financial stringency cannot be shelved. For certain aspects of them the scientific worker himself must accept responsibility, and it is indeed only as he works in closer alliance with the designer and artist that we can hope for a full solution. Science has once more set mankind the task of harnessing new forces not merely to utilitarian but also to æsthetic purposes, and in the advent of an age of leisure the latter assume even greater importance. The man of science has much to contribute to the full understanding of the properties of the materials of industry and the processes by which they are worked. The artist has to transmute the material and the processes so that the outcome may be a product which ministers to man's artistic and æsthetic needs as well as to his material needs or comforts—"beautiful and quaint in design but also adapted for every day service and decorous in humble and secluded life". The Gorell Committee in its report does well to stress that note of service upon which both art and science depend, in which they have their strongest common bond and most splendid spur of rivalry in their contribution to the amelioration of the human race.

A Vanished World

Biographical Fragments. By Sir Arthur Schuster. Pp. xiii + 268 + 8 plates. (London: Macmillan and Co., Ltd., 1932.) 10*s.* 6*d.* net.

THE world of 1851, the birth year of Arthur Schuster, differed almost *toto caelo* from the age which has witnessed the publication of these biographical fragments. Posting as a means of travel was not altogether a thing of the past; the electric telegraph was still a novelty; the telephone had not yet appeared upon the scene. In the England of that era, shopkeepers in the capital still lived over their shops; merchants drove into the city in horse-drawn carriages, or rode in on horseback; for sixteen years to come malefactors were strangled outside Newgate in the presence of roaring crowds.

Of this civilisation, Frankfort, Schuster's birthplace, was a fascinating microcosm. The confederacy of German States which ensued on the break-up of the Holy Roman Empire had its Diet located at Frankfort, which in consequence took on something of an international character. On the outbreak of the war between Austria and Prussia in 1866 the city declared its neutrality but nevertheless had to submit to the entry of the triumphant Prussian troops; and Sir Arthur, from first-hand knowledge, draws a most graphic picture of this vanished world with its clanking dragoons, its whispering statesmen and ambassadors and, towering over all, the vast figure of Bismarck, then in his most arrogant *Blut-und-Eisen* mood.

Schuster tells us, too, something of his school-days in Frankfort, of his life as a student at Geneva and of his early days in England when, despite his longing for a scientific career, he found himself, an apprentice in the firm of Schuster

Brothers, copying letters and checking accounts in their office in Sackville Street, Manchester. It is not without a smile, too, that we read of the house taken by his father at Lytham under the impression that that homely Fylde seaside village was the Nice of England. A scientific career being decided upon, he gives us some account of the Quay Street period in the development of Owens College, of his wander-years, and of the circumstances that led to his taking charge of the eclipse expedition to Siam in 1874. Of this expedition and of its sequel, a journey through India, we have a most interesting and vivid account, and then, when we are looking forward to the tale of that splendid outburst of activity which marked Schuster's tenure of the chairs of applied mathematics and of physics at Owens College, the curtain rings down on the main theme, and the remainder of the book is concerned with a series of episodes and a number of admirably drawn sketches, which appeared originally in NATURE under the title "Biographical Byways", of eminent men of science of a generation that has gone.

The fragments that fall from Sir Arthur's table provide better fare than many another man's banquet, and we are most fortunate in possessing these skilfully etched portraits, giving life to many a personality otherwise but the shadow of a name. We see Henry Wilde, one day telling Schuster that he was unfit to be a university professor, the next day making amends for his hasty words by a present of hothouse grapes; Joule, receiving his manuscript rejected by the Royal Society, and envisaging a committee of rejection who should say "What good can come out of a town where they dine in the middle of the day"; and Balfour Stewart, of whom Sir Arthur gives a most sympathetic and understanding account, remarking "every billet has its bullet", after reading a letter from the Principal of the College in which the sting was distinctly in the tail. Leverrier, Boltzmann, Kirchhoff, Bunsen, Weber, Helmholtz, Reynolds, Stokes .... it is a remarkable gallery, and we are very much in Sir Arthur's debt for these studies sketched with both kindliness and insight; specially valuable are the accounts of Wilde, Stewart, Boltzmann, and Reynolds.

But we miss the story of Joule's Stone Ales!

Of the minor episodes, the tale of the thief and the barograph is not without human and scientific interest. A worker in the laboratory missed coins from the pocket of a coat which he left hanging overnight. Suspicion fell on a charwoman and a night-watchman, who visited the room at different times. A decoy coin was left in the coat pocket, so arranged that its removal would break a simple circuit and cause the pen of the barograph to make a jerk in its time record. The experiment was completely successful; the honour of the charlady was vindicated; and the peccant (and, we trust, repentant) figure of the night-watchman vanishes into the mists of forty years ago.

We close the volume with regret; not the least valuable of the impressions which have remained is that of the author himself, a great genius, versatile, kindly, humorous, and charitable; one who has seen much, and suffered not a little; who has followed the scriptural injunction to prove all things, and hold fast to that which is good. May we express the hope that he will find himself able to unfold to us the story of the development of the Manchester school of physics—a story which none can tell as he can, and in which he himself has played so great a part?

ALLAN FERGUSON.

Invertebrates

The Invertebrata: a Manual for the Use of Students. By L. A. Borradaile and F. A. Potts. With Chapters by Prof. L. E. S. Eastham and J. T. Saunders. Pp. xiv + 646. (Cambridge: At the University Press, 1932.) 25*s*. net.

THIS volume has been prepared for the use of students who have completed a year's study of zoology and are entering upon an advanced course. The book opens with an admirable introduction to the study of the structure and biology of the Protozoa, after which follows the systematic consideration of the four main sub-divisions, including a scheme of classification and references to the special points exhibited by representative examples. This chapter is especially praiseworthy for the attention devoted to free-living forms. The student tends to stress the parasitic Protozoa and this account provides a most useful corrective, and he who reads and digests this chapter of 109 pages will have acquired a sound and balanced basis of knowledge of the Protozoa.

A brief account of the sub-kingdom Parazoa (Porifera) follows and the rest of the volume is devoted to the invertebrate Metazoa and to two sub-phyla of the Chordata—the Enteropneusta and the Tunicata. For each of the more important phyla or sub-phyla a concise definition is given and is followed by observations on the general structure and development; the sub-divisions are defined, a representative example is usually described and references made to other genera which serve to illustrate special points in anatomy, life-history and biology.

The chapters on Crustacea (85 pp.) and insects (60 pp.) may be mentioned for their excellent treatment of the subject and for the quality of the illustrations.

The author of the chapter on Nematoda, in a brief discussion on the systematic position, holds that the simple structure of the nervous and muscular systems and the absence of vascular system are signs of a lowly origin and not of degeneration, and that there is no real connexion between these worms and the Arthropoda. He points out that the Nematoda present no signs of segmentation or appendages, the cuticle is of an entirely different chemical nature in the two phyla and the loss of cilia in the Nematoda is certainly secondary.

The text is supported by well-chosen illustrations, mostly in line, many of which are either original or are drawn from recent memoirs. The figure of the larva of *Echiurus*, from Hatschek, which shows the septa of transitory segments, would have been better replaced by one of Baltzer's representing the mesoderm as unsegmented, as it appears actually to be.

The work has been carefully planned and the authors have been at great pains to arrive at a fair balance of its principal parts. They state that the choice of examples has been difficult and that they have not been able to include all they could have wished. The omission of the Mesozoa is probably justifiable, but whether for example *Gordius* with its interesting life-history should have been entirely ignored is more doubtful. The authors have imposed on themselves a restriction in extent of the text which in places is rather severe, for example, the Hydrocorallinæ are dealt with in twenty lines, the Gephyrea in twenty-three and the Phoronidea in a dozen lines of text (but for each group there are also one or two illustrations with adequate legends), and of the Heteropoda only *Pterotrachea* is mentioned and of the Pteropoda only *Cavolinia*. It is, of course, recognised that to bring an account of the Invertebrata within the compass of a single volume of 600 pages compression is necessary, and it must be admitted that the authors have dealt on the whole judiciously with the conflicting claims for space of the different groups.

Errors are remarkably few and unimportant, and the proof-reading has been effective so that misspellings are very scarce. It should, however, be noted that *Ancylostoma*, not *Ankylostoma*, is the officially recognised form of this generic name. The authors are to be warmly congratulated on a work which is concise, accurate and adequately illustrated, and is a compendium of the most significant knowledge on invertebrates.

A New Surrey Flora

Flora of Surrey: being an Account of the Flowering Plants, Ferns and Characeæ, with Notes on the Topography, Climate and Geology, and a History of the Botanical Investigation of the County. By C. E. Salmon. Edited by W. H. Pearsall. Pp. 688. (London: G. Bell and Sons, Ltd., 1931.) 42*s*. net.

ALL those interested in British plants will welcome the appearance, after so many years' delay, of this new "Flora of Surrey". At the end of last century, W. H. Beeby was working at a new "Flora" of the county, but he did not complete his project and, in 1908, handed his manuscripts over to the late C. E. Salmon. His untimely death unfortunately prevented Salmon, in turn, from finishing the "Flora" and the volume now appears under the editorship of Dr. W. H. Pearsall, who is responsible for the introductory chapters and about one-third of the genera. The greater part of the work, however, is Salmon's, and the volume, with his portrait as a frontispiece, will remain as a lasting memorial to his unrivalled knowledge of the British flora.

There are excellent introductory chapters on the topography, climate, geology and botanical history of the county, together with a very full list of the authorities consulted. The "Flora" itself is, on the whole, admirably arranged, and especially valuable are the taxonomic notes and personal observations at the end of many of the species entries. It seems, however, an unnecessary waste of space to quote pre-Linnean names under each species; sometimes these occupy two or three lines and do not add to the value of the work. Under *Polygala* there is a reference to an appendix containing a key to the British species; no such appendix appears, however, to be in the volume.

The botanical value of the "Flora", as was to be expected from the authorship, is considerably greater than that of many works of a similar kind. Full treatment is accorded to critical genera and, in most cases, their distribution in the county is worked out in detail (for example, Batrachian *Ranunculus*, *Viola*, *Epilobium*, *Rubus*, *Rosa*, etc.). A useful feature is the constant reference to the literature of difficult groups. It is to be regretted, however, that these references do not include work on experimental and genetical lines as well as purely systematic papers. Under *Erophila*, for example, the work of Rosen and Winge might have been mentioned as well as that of Jordan; and under *Hieracium* there is no reference to Ostenfeld's researches on the apogamy of the genus. In omitting work of this type an opportunity has been missed of bringing into closer touch the old and the new schools of taxonomy. Unless this can be done, no further advance in our knowledge of the British flora is possible.

This, however, is a general criticism, applicable, unfortunately, to a great deal of the work on the British flora during the last thirty years, and does not prevent the volume from being one of the most attractively produced and valuable of our county 'floras'. The illustrations of places of botanical interest in the county and the two maps add considerably to its interest, and also, unfortunately, to its price, which is surprisingly high, even for a work of such limited circulation. Dr. Pearsall is to be congratulated on bringing to successful completion a work which has passed through so many vicissitudes during the last forty years.

Practical Organic Chemistry

Laboratory Methods of Organic Chemistry. By L. Gattermann. Completely revised by Heinrich Wieland. Translated from the Twenty-second German Edition by Dr. W. McCartney. Pp. xvii+416. (London: Macmillan and Co., Ltd., 1932.) 17*s*. net.

THIS is one of the classic textbooks of the organic chemist; there can be few who have not made use of it at the beginning of their manipulative training even in Great Britain, and the reviewer can plead guilty to struggling with the first edition, dated Heidelberg, August, 1894, in the original German in his student days. In issuing the nineteenth edition from Freiburg in 1925, H. Wieland, the successor to Gattermann, emphasised the fact that the equipment which sufficed during the last three decades has now become insufficient for those who desire to work at present-day problems, so that in rewriting the book the theoretical and practical requirements have been deliberately increased. We now have the twenty-second edition dated from Munich in July, 1930, with the English translator's date of April, 1932, which shows many changes, all directed to place the student in contact with modern fields of inquiry. Thus, two enzyme preparations have been included, and a biochemical flavour, showing the trend of the times, is also imparted by the preparation of natural compounds, such as furfural, glucose, arginine, nicotine, hæmin and the constituents of bile.

The number of preparations is, of course, in excess of what any student can complete in his course of about a year's training—in Munich it is usual for the student to carry out fifty to sixty preparations, as well as some six or eight from the original literature. The translation into English appears to be well made; and this new edition will be welcomed by students of practical organic chemistry unfamiliar with the German language. Serious students ought, however, to work through such a book in the original German—in no other way can they obtain so easily the essential knowledge of the construction and vocabulary of chemical German.

It would be attractive to use the first and the newest editions as the basis for moralising on the advances in organic chemistry during thirty-six years and on the method of teaching it, but lack of space prevents this being done here. At least it is more important to-day than ever that the worker must be a practical manipulator of the highest skill; and Gattermann's course of work is admirably designed to attain that end.

E.F.A.

On the Roof of the Forest

A Naturalist in the Guiana Forest. By Major R. W. G. Hingston. Pp. xiii + 384 + 16 plates. (London: Edward Arnold and Co., 1932.) 18*s*. net.

THE treetop canopy of the Amazons forest has always attracted the attention of naturalists; but hitherto the difficulties of exploration in this 'forest above the forest' have been thought to be almost insurmountable. The success of Major Hingston and his colleagues of the Oxford University Expedition to Guiana was due, not only to good organisation but also to perseverance and enterprise. Most of the party were young and with no previous experience of the tropics; and it says much both for the fine discipline of modern youth and for the wisdom of their leader that they lived successfully under canvas for months, thus disposing once again of the old idea of the dangers of camping in the jungle. In fact, such was the excellent organisation that we are told: "We always if we wished it could have a hot bath daily, and we always had our meals off a clean tablecloth."

The book is made up rather unevenly of two parts. The first, which contains an account of the general work of the expedition, is the most interesting and contains vivid descriptions of the forest, which, unlike the perorations of some other writers on the subject, never flush to 'precious purple'. The story of the attempts to establish a footing in the treetops makes exciting reading. Rather surprisingly, the arboreal ants and bees did not prove so ferocious as anticipated; and the rope-throwing rockets and other apparatus were less efficacious than the more primitive methods of the climbing Indian. Observation posts were planted as high as 120 feet; and the records obtained demonstrated what had previously been only suspected, namely, the well defined vertical distribution of life in the trees. For example, it was found that moths dominated the night fauna of the forest at ground level, and Hemiptera in the treetop roof. There remains a rich field for investigation into the different ecological factors —light, humidity, etc.—which condition animal life in the various zones.

The second part of the book, which deals with specific observations chiefly on the protective devices of spiders and caterpillars, is grafted a little clumsily on the first. Major Hingston is a whole-hearted believer in the mimicry theory, and he gives here a number of instances that came under his notice in Guiana. Most of them are new, all of them are interesting, but the section on spiders' snares overweights the book a little and would be better if abridged. Mimicry, having held the field for years against assaults on the theory of natural selection, has recently been sharply challenged; and new instances, if they are to help the case, must be beyond cavil. From this point of view the example of the Ascalaphid on p. 281 is of doubtful value, and that of *Laternaria* with its 'alligator-like' head never seems very convincing.

The book is illustrated by some excellent line drawings of the devices that the author describes; and by some adequate, though not outstanding, photographs of the forest.

M. D. B.

Short Reviews

(1) *Patents, Trade Marks and Designs: their Commercial Aspect and Development.* By Charles Waldron Thomas. (The Nutshell Series, Vol. 1.) Pp. 88. (London: Ocean Publishing Co., 1932.) 4*s*. 6*d*. net.

(2) *British Patents and Designs Statutes as Amended and Consolidated to 1932.* With an Introduction and Index by H. J. W. Bliss. Pp. viii + 126. (London: Stevens and Sons, Ltd., 1932.) 4*s*. 6*d*. net.

(1) This book is remarkable, and probably unique, for its admirable advice on the business details connected with the exploitation of inventions from the point of view of the inventor. It gives an excellent summary of patent law and procedure, adequate to the needs of an applicant for a patent who is prepared to employ a patent agent, and this part of the book takes cognizance of the changes introduced by the Patents and Designs Act, 1932. Of considerably greater interest, however, is the astute advice, characterized by much worldly wisdom, given by the author on the commercial aspect of inventing. The limits of the advantages to be gained by mass production, the question of price, advertising, the characteristics of mail-order sales, are some of the topics on which light is shed. The author is something of a psychologist, as when he utters the warning: "Unfortunately the personal friends of inventors are apt to praise any invention out of friendship. . . ." Sir Richard Gregory contributes an interesting foreword in which he discusses some famous patented and unpatented inventions.

(2) This comprises the various patents and designs acts now in force, in consolidated form, together with an alphabetical index to their subject-matter, references being to sections of the consolidated acts; and also a summary, arranged alphabetically on the basis of subject-matter, of the changes introduced by the Patents and Designs Act, 1932.

C. W. H.

Die mitogenetische Strahlung, zugleich zweiter Band der "Probleme der Zellteilung". Von Prof. Dr. Alexander Gurwitsch. Unter Mitwirkung von Lydia Gurwitsch. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 25.) Pp. ix + 384. (Berlin: Julius Springer, 1932.) 33.80 gold marks.

During the past decade, the writings of Gurwitsch and others have made biologists familiar with the conception of mitogenetic rays, that is, radiations emitted from one organic body which stimulate or increase the rate of mitosis in another. The latter biological object is called the detector, and the process of stimulation is known as a mitogenetic effect. Biologists are, however, not yet convinced of the nature or even of the existence of mitogenetic rays.

The present volume explains the methods and instruments used in such experiments and discusses the results, especially in their biological aspects. The book is divided into three parts, dealing respectively with the physics and chemistry of mitogenetic rays, their occurrence in the economy of organisms, and the various biological aspects of the 'mitogenetic effect'. These rays are believed to be produced by bacteria and yeasts as well as the meristems and phloem of higher plants, while other tissues are thought to produce them after wounding or necrobiosis. Experiments also described are supposed to show their production by animal embryos, tissue cultures, blood, ciliated and nerve cells, and numerous experiments with carcinomata are set forth. Since the proof of an induction or mitogenetic effect depends upon the counting of the relative frequency of mitotic figures in the exposed tissue, the difficulty of proving even a single case will be clear.

The real nature of these effects remains to be proved, but anyone interested in the subject will find the experimental work well summarised in this volume. R. R. G.

Medieval Faith and Fable. By the Rev. Canon J. A. MacCulloch. Pp. 345. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1932.) 15*s*. net.

IN "Medieval Faith and Fable" Canon MacCulloch deals with various aspects of religious life and thought in the Middle Ages, regarding them as a student of folk-lore and comparative religion rather than as a theologian. It is generally recognised that the rank and file of the early Christian Church retained many of their pagan beliefs; while popular observance of ecclesiastical feasts and festivals often was allowed to incorporate a considerable element of an earlier ritual. This, however, is not all. The doctrine of the early and medieval Church was itself in many respects an assimilation of conceptions derived from the religions which preceded it.

Canon MacCulloch, bringing his extensive knowledge of elder faiths and folk-lore to bear upon the Middle Ages, here shows to what extent the elements of paganism may be detected as surviving in the medieval view of such matters as fairies, the supernatural mistress or wife, demons, the cults of the Virgin and the saints, the Host, miracles and so forth. One of the most interesting and informative of his chapters deals with medieval heresies, which, when regarded from the point of view taken here, throw much light on the witchcraft belief and persecutions, a subject which the author reserves for future treatment. Canon MacCulloch's knowledge of his subject is encyclopædic. He wastes little time on theory, but gives his readers facts in full measure, not to say running over.

The Atomic and Molecular Forces of Chemical and Physical Interaction in Liquids and Gases, and their Effects. By Prof. R. D. Kleeman. Pp. vii + 133. (London: Taylor and Francis, 1931.) 10*s*. 6*d*. net.

THE difficulties inherent in the task of giving a coherent theory of the fluid state of matter are illustrated in this volume, in which Prof. Kleeman discusses the nature of the law of force between the atoms and molecules of liquids and gases. The physical and chemical properties of fluids must evidently be conditioned by this law, but since the molecules may be in rotation, the law must necessarily be complicated in character. The law can, however, be shown to possess some general functional properties that hold approximately. Prof. Kleeman points out an important property of the force exerted by an atom, namely, that it is measured by the square root of the atomic weight.

The volume contains at least 175 equations, some theoretical, some purely empirical, and some of a hybrid character. How many of the equations in the latter classes will survive critical examination it is difficult to say. Prof. Kleeman has done a useful piece of work in collecting this material but much original investigation, probably on quite new lines, is still required before satisfactory theoretical conclusions can be reached.

The Neural Energy Constant: a Study of the Bases of Consciousness. By John Bostock. Pp. 178. (London: George Allen and Unwin, Ltd., 1931.) 6*s*. net.

DR. BOSTOCK advances a theory that "the nerve energy engaged in consciousness is a constant quantity". It cannot be said that he makes out a good case in support of his theory. His diagrams are like so many of those produced by writers on psychology, probably best understood by himself. There is a number of irritating spelling mistakes and grammatical errors, which should have been eliminated. The statement "fortunately for science this region [the thalamus] is very frequently the site of small hemorrhages" is inaccurate. The thalamic syndrome is distinctly rare. What is described in the text as the *oc*cipital lobe is figured on a diagram as the *de*cipital lobe. The old proverb "when in doubt sleep on it", does not, as the author would have us believe, mean that some mental process full of wisdom takes place during sleep, but simply that on thinking a question over more carefully, and using our judgment more wisely, we may alter our view. There is no need for the author to be troubled at "the intellectual brilliance of many epileptics". They are most certainly the exception; the proportion of clever people among epileptics is distinctly smaller than amongst the normal population.

Effects of Solar Eclipse on Audio Frequency Atmospherics

By EVERETT T. BURTON and EDWARD M. BOARDMAN, Bell Telephone Laboratories, New York City

STUDIES of low-frequency atmospherics have shown marked diurnal variations, the night-time intensity considerably exceeding that of the day.[1] These variations may be attributed to radiation from the sun through its effect on ionisation in the reflecting and absorbing layers of the upper atmosphere. Although it is believed that the major portion of this ionisation is due to sunlight, an appreciable effect may be due to a corpuscular radiation from the sun. A solar eclipse affords an opportunity for comparing light and corpuscular effects, since a difference in velocity of these types of radiation should result in a time separation of the two eclipses at the earth's surface. Prof. S. Chapman[3] has shown that, with an assumed corpuscular velocity of 1,000 miles a second, the corpuscular eclipse precedes the visible one by about two hours. The motion of the moon through a corpuscular radiation results in a trailing shadow. In overtaking the visible shadow of the moon, the earth arrives first at the location of the corpuscular shadow.

Observations of atmospherics during the progress of a solar eclipse should show at least an approximation to night-time conditions, because of the accompanying reduction of radiation intensity. The effects of the two types of radiation on the ionisation in the atmosphere should be sufficiently separated in time to render their effects distinct. To obtain experimental data, apparatus was set up at Conway, New Hampshire, which was in the path of totality of the solar eclipse of August 31, 1932. A vacuum tube amplifier was connected to a vertical loop antenna which consisted of two sections placed at right angles to reduce directional effects. Between the loop and the amplifier were placed networks so designed that all frequencies above the range of interest were eliminated, thus insuring direct reception of audio frequencies without a detection process occurring anywhere in the apparatus. The amplifier output was connected to a thermocouple for amplitude measurement and to a telephone for aural observations. The amplifier gain was essentially uniform from 20 to 3,800 cycles per second. The telephones were of the dynamic type with regular response throughout the voice range. These permitted more accurate observations on static qualities than have been possible with the telephone receivers used heretofore. A calibrated tone circuit, loosely coupled to the amplifier system, was provided for use in determining frequencies of musical atmospherics.

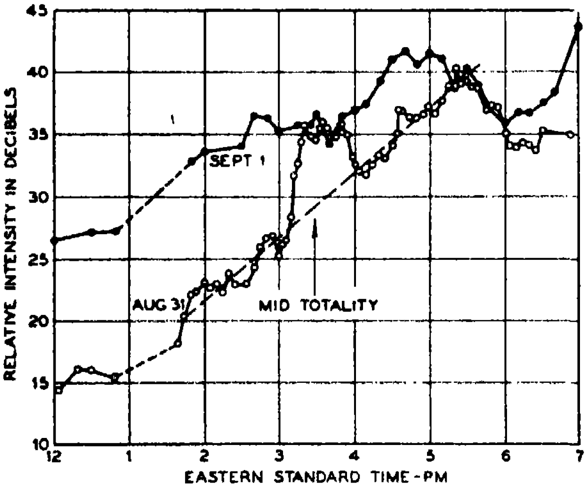

FIG. 1.

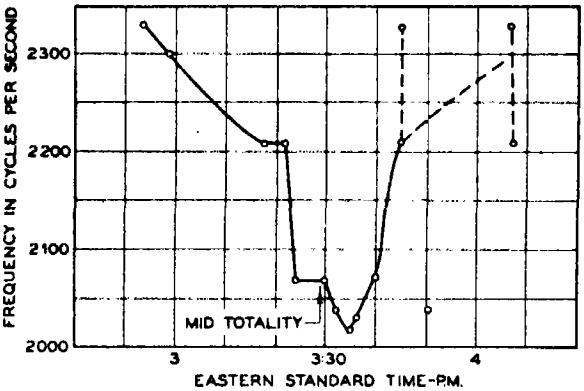

FIG. 2.

Tests at Conway extended from the evening of August 30 until the morning of September 2. Frequent determinations of static amplitude and of static tonal qualities were made. The atmospheric intensity during all of this time was unusually high because of the presence of musical atmospherics of the previously reported type known as 'swish'[1]. While the 'swish' obviously was not related to the eclipse, its presence was unfortunate because of the introduction of irregular variations of intensity. The static intensities for the afternoons of August 31 and September 1 are shown in Fig. 1. While the two curves follow the same general contour, that of the former date shows an abrupt rise shortly before the time of eclipse totality and an abrupt fall after totality. The duration of this period of high intensity is 55 minutes, its mid-time occurring 5 minutes after mid-totality.

Certain types of so-called 'musical atmospherics' normally occur only during twilight or night. One of these, known as the 'tweek', is a short damped oscillation which appears to result from multiple reflections of a static impulse between the earth's surface and a reflecting layer located in the upper atmosphere. 'Tweeks' have never been observed during full daylight, their existence evidently being prevented by absorption in the low-altitude ionisation maintained by sunlight. A phenomenon closely related to the 'tweek' is a weak resonance, observed during evening and morning twilight periods. The resonance has been found to appear near sunset with a frequency of approximately 2,300 cycles per second, reducing gradually to 1,800 cycles per second in approximately two and a half hours, after which it appears to submerge in the night-time static. During the morning twilight period the resonance reappears, rising through the same frequency range and persisting for approximately half an hour. The 'tweeks' suffer similar frequency variations during the twilight periods.

A watch was kept for tonal qualities in the static during the entire day of the eclipse. Shortly after noon, occasional very highly damped oscillations were observed, resembling somewhat the night-time 'tweeks'. Seventeen of these were observed between the hours of 12.35 and 3.50 P.M., a good share of them occurring just previous to one o'clock. While our data are meagre, there is evidence of a maximum in this effect occurring somewhere between two and three quarters and one and a half hours before the time of visible totality. This uncertainty results from the fact that no observations of tone were made between the hours of one and two in the afternoon. As totality approached these highly damped tones were seldom observed, but a weak resonance similar to that of an evening twilight period appeared. The frequency was observed to reduce gradually, reaching its minimum approximately seven minutes after totality. Thereafter it increased rapidly, and disappeared after a short period of rather indefinite frequency. The observations of the resonance tone are shown in Fig. 2.

Our observations of audio-frequency atmospheric intensity indicate an approach to night-time intensity near the period of totality. Data on resonance tone indicate an approximation to evening conditions before and during totality, followed by a condition similar to that of morning. Both the intensity and tonal data show lags of a few minutes in respect to the time of totality. These observations point to sunlight effects on the ionisation of the atmosphere. The occasional occurrence of the highly damped tones long before the time of visible totality may be taken as evidence of the existence of corpuscular radiation, although the data indicate a minor effect. The difference in tonal quality between the early highly damped oscillations and the resonance observed near the time of visible totality indicates the occurrence of some marked change in the atmospheric conducting or reflecting properties, due possibly to difference in penetrating properties of the two types of radiation.

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[1] E. T. Burton, "Submarine Cable Interference", NATURE, 126, 55, July 12, 1930.

[2] S. Chapman, "Influence of Solar Eclipse Upon Upper Atmospheric Ionization", *Mon. Not. Roy. Ast. Soc.*, **92**, 413; 1932.

Infestation of Stored Products by Insects

By Prof. J. W. MUNRO, Imperial College of Science and Technology

ALTHOUGH the losses caused to growing crops by insects have long been recognised, the losses caused to crops after harvesting and during storage and transport have been strangely neglected both by the biologist and the industrialist. These losses are none the less of grave importance and take in the main three forms: absolute loss of goods resulting from consumption by the insect, indirect loss resulting from the lower price paid for soiled or infested produce and indirect loss resulting from loss of prestige by the merchant or manufacturer who inadvertently places infested produce on the market. This last form of loss is almost wholly incalculable, but that it is high is evident from the almost extravagant care which our food industries take to prevent any knowledge of infestation from reaching the general public.

In 1926, the Empire Marketing Board appointed a committee—Committee on Stored Products Infestation—to consider this problem and on its recommendation made a grant to the Imperial College, in 1927, for the establishment of a special laboratory for the study of the scientific problems underlying infestation of stored products by insects and fungi.* This laboratory is stationed at Slough, near London. Its work is divisible into three main sections: survey and intelligence work at the London docks; research and experimental work in the laboratory; and commercial scale experimental work on sterilisation of infested produce and warehouses in London and other ports.

The survey or intelligence work is concerned with inspection of such produce as cocoa[1], dried fruits[2] and tobacco[3] on its arrival in London, with a study of the special conditions—economic and climatic—prevailing in the dock warehouses and their relationship to infestation, and with the examination of special 'experimental consignments' of produce shipped from oversea for the purpose of testing methods of preparation, packing and transport and their relationship to insect infestation. With this inspection work there is also regular correspondence and exchange of programmes with departments of agriculture and other institutions in the Dominions and Colonies on problems arising in the work.

A survey of the insects associated with cocoa, dried fruits, spices and tobacco stored in London warehouses showed that upwards of a hundred and forty species of insect are represented, but of these only a few are of primary importance'.[4] These are the phycitid moths of the genera *Ephestia* and *Plodia*, of which the 'flour moth', *Ephestia kühniella*, the 'cocoa moth', *Ephestia elutella*—which is also a serious pest of stored tobacco—and the Indian meal moth, *Plodia interpunctella*—the major pest of dried fruits—are much the most important economically.[5] Of the Coleoptera, the grain weevils, *Sitophilus granaria* and *S. oryzae*; the flour beetle, *Tribolium castaneum*; the 'saw-toothed grain beetle', *Oryzœphilus surinamensis*; the 'biscuit weevil', *Sitodrepa panicea* and *Ptinus* and *Dermestes* species, are the more important or more prevalent.

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* The term 'stored products' as used here excludes timber, which is dealt with by the Forest Products Research Laboratory of the Department of Scientific and Industrial Research.

The characteristics of the stored products fauna have been discussed by van Emden and by Richards[6]. The chief of these appear to be low water requirements and lack of specialised oviposition response.

The main results of the survey work so far have been to show that in nearly all—if not all—instances, infestation begins in the exporting country and that it is aggravated by storage in Great Britain. The work has also served to show that close co-operation of the producers, merchants, wharfingers and manufacturers is essential if freedom from infestation problems is to be attained. In the dried fruit industry it has been clearly shown that due precautions taken in the packing sheds of the exporting country will ensure lower insect infestation of fruit on its arrival in Great Britain.

The laboratory research and experimental investigations in progress comprise entomological, mycological and chemical work. In the entomological branch, the problems studied are concerned mainly with the rearing of very large numbers of insects for experimental work on such lethal agents as heat, cold and fumigant gases, and with various problems relating to the respiration of insects in different stages of development. Of special interest is a study of the factors governing the fertility and rates of increase of the phycitid moths. A description of the pairing habits of these moths has been published[7] and an account of sterility produced in the males by rearing at temperatures above the optimum for development awaits publication.

In the mycological branch of the laboratory, special attention has been given to copra[8] and to cocoa[9] and an extensive programme of work on the taxonomy and physiology of the mould-causing fungi of the genera *Penicillium* and *Aspergillus* has been begun.

In the chemical section of the laboratory, research and experimental work on the relative toxicity of various fumigants to insects and on the partial vapour pressures of fumigant vapours and gases generally used in admixture, for example, ethylene dichloride and trichlorethylene has been carried out and awaits publication. Especially important is a study of the methods of measuring the concentration of gases during fumigation[10] and the devising of special apparatus for this purpose. Work on the methods of determination of the fumigants ethylene oxide[11] and hydrocyanic acid, both in the air spaces and in the products fumigated has made good progress.

The commercial scale experimental work undertaken by the laboratory has been made possible by the generous facilities placed at its disposal by a number of interested firms, among whom Messrs. Weber, Smith and Hoare, wharfingers, and the London agency of the Australian Dried Fruits Board deserve special mention. While laboratory experimental work has very high value, it is almost impossible to simulate in the laboratory the extraordinarily varied conditions affecting sterilisation on a commercial scale. Where cold lethal temperatures are employed, the chambers used in commercial cold storage have been found satisfactory and this method is especially applicable to the sterilisation of almonds and nuts and tobacco. Where, however, fumigation is employed, the problems are many and difficult, for some of these warehouses have a capacity of 250,000 cubic feet and house many hundreds of tons of produce.

In fumigation of ships, warehouses, mills and produce as practised commercially, it was found that no serious attempts are made to determine the behaviour of the gases used during the actual process of fumigation. Moreover, such concentrations of fumigants as are recommended or employed in practice are based on experimental work in which the kind and extent of living insect material used are quite inadequate. Five, ten or, in rarer cases, thirty insects of unknown antecedents appear to be considered ample for this work. In our experience, such numbers are far too small and until we were employing in our commercial work from 2,000 to 4,000 insects or insect eggs reared or produced under known conditions, we were not satisfied with our results. A study of the behaviour of gases during fumigation showed that temperature effects are not allowed for at all, the very high absorption of fumigants by the products themselves and by such things as walls and 'dunnage'—boards used as a base for piles of fruit boxes, sacks, etc.—is altogether underestimated and quite inadequate measures are taken to ensure proper diffusion and distribution of the gas. It is probable that the most important direct contribution our laboratory has so far made to the 'control' of insect infestation is in directing attention to these defects and providing means of overcoming them. The methods used in measuring concentrations of gases in fumigation have already been described elsewhere[10]; meanwhile, two very important advances in the technique of fumigation have followed. On one hand a higher percentage of destruction of the insects has been secured, and on the other, a more uniform distribution of the gas has been attained, even in very large warehouses in cold weather. This work is, of course, still in the experimental stage, but there is every reason to hope that soon we may find commercial fumigation placed on a scientific basis, with the result that it will be safer for those engaged in it, more efficient against insects and less injurious to the product treated.

Efficient fumigation, however, is not the final aim of our work, which is the reduction of infestation at its source, and while physical and chemical measures may prove palliative, it cannot be too strongly emphasised that the ultimate reduction of the losses caused by insect infestation of stored produce depends on the acquisition of a fuller knowledge of the insects concerned than we possess at present. Subjects on which promising research work is being conducted as time and funds allow are the temperature and humidity conditions—both in the atmosphere and in the products—which are most favourable to various insects, and the relationship of the mould-causing fungi to the insects' food supply. For the present, this research work may appear of less practical importance than the improvement of remedial measures, but as these measures lessen the incidence and extent of infestation and more attention is given to preventive measures, the value of the more purely biological research work will be more appreciated. Already in some of the industries affected by insect infestation of their raw materials, the need is felt for fuller knowledge of the influence of ventilation and air conditioning and of different kinds and intensity of lighting on the prevalence of warehouse insects.

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Museums of Canada*

THE two volumes referred to below may be regarded as a continuation, first, of the report on the public museums of the British Isles drawn up for the Carnegie United Kingdom Trust by Sir Henry Miers in 1928, secondly, of the new edition of the "Directory of Museums", originally published by the Museums Association in 1911, of which vol. 1, covering Great Britain and Ireland, appeared in October 1930. This continuation, which will eventually deal with all the public museums of the Empire, has the aid of the Carnegie Corporation of New York. The report, by Sir Henry Miers and Mr. S. F. Markham, is confined to the museums of Canada, but the "Directory" comprises also the other museums on or adjoining the American continent and is on the same clear and practical lines as the first volume. We base our further remarks on the Canadian report.

The authors include any building that houses objects of art, history, science, or industry to which the public has even limited access. Of such museums they reckon 125, and nearly all have been inspected by one or the other author. The *museum service of Canada differs from that of* Great Britain in the relatively smaller number of museums maintained by public funds. While 28 are administered by the Dominion Government or provincial governments and only seven by a city or county, *there are 32 maintained by a* society, 53 by educational establishments, and *5 owned by industrial firms*. The classification is not exact as the administration is often shared between public and private bodies. Of the society museums, at least half are historical, and these are mostly in Ontario; of the educational museums *22 belong to Roman Catholic institutions in* Quebec. Fifteen, of varied character, are classed as art museums and range through eleven towns from Vancouver to Halifax.

While a few of these museums, both large and small, are on a high level, it is not surprising that many are open to the criticisms that not so long ago were passed upon most of the museums in Great Britain. To the defects of building with which we are familiar, especially when collections are shown in a house not intended for that purpose, is frequently added that danger from fire natural in a country where wood is used so largely. Save in the half-dozen leading museums, cases are not dust-proof and often not moth-proof, or even lacking altogether. While some exhibits are commended, there is generally a want of adequate labelling and in this respect the art galleries, as elsewhere, are sadly to seek. Still worse is an absence of plan, so that objects which might teach a lesson remain mere curios; here the special museums have an advantage over those covering a wider field. Underlying all these defects is, as usual, the lack of a proper staff. It is almost incredible that "only in a score of museums . . . is there a competent full-time curator, and that in only eight of the score are there adequately qualified museum assistants". Not only this, but also the best of the curators are attracted to the United States by the higher pay and status.

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* A Report on the Museums of Canada, by Sir Henry A. Miers and S. F. Markham, to the Carnegie Corporation of New York, to which is appended a Directory of the Museums of Canada and other parts of the British Empire on the American Continent. Pp. vi + 63 + 2 plates. Directory of Museums and Art Galleries in Canada, Newfoundland, Bermuda, the British West Indies, British Guiana and the Falkland Islands. Compiled by Sir Henry A. Miers and S. F. Markham. Pp. 92, 5s., with Report. (London: The Museums Association, 1932.)

It is plain that Canada, in spite of its fine schools, universities, and public libraries, has not yet realised the educational value of museums, a value that has only recently been admitted in Great Britain. There are indeed some school museums, but most of them are neglected and bear no more relation to the curriculum than with us. In nearly half the museums, some instruction is given to school classes, but there is no true co-operation with the educational authorities. Thirty museums lend specimens to schools and a few are really active in this direction. These are hopeful signs and one can scarcely doubt that the lead of the United States will before long be followed.

Looking at the state of affairs still more broadly, the authors find an absence of co-operation. Were this need supplied, the few really good museums could do much to raise the general level. Towards future progress the criticisms and suggestions of this most valuable report cannot fail to be an inspiration and a guide.

Obituary

DR. ERNEST CLARKE

ERNEST CLARKE was a well-known London eye-specialist. Born in Hampstead on July 21, 1857, he died on November 22, 1932. His career is well described in the medical journals of December 3. Educated at University College School, he joined St. Bartholomew's Hospital Medical School in 1876. He began his career in 1880, as a general practitioner at Blackheath but soon turned to ophthalmic work and moved to Chandos Street, W. He was very successful, through making the correction of small errors of refraction his special care.

A linguist, a traveller, a musician specially devoted to the organ, an enthusiastic collector, a keen freemason, gifted with a cultivated mind, both artistic and scientific, Clarke was a most engaging personality. Happy in his success, he enjoyed good health until recent years, when he suffered much as a result of some infection, I believe, but was stoically cheerful and active to the last. A member of the Royal Institution since 1896, he was a constant attendant and one of its most valued helpers.

I knew him in his student days, as an alert member of my First M.B., University of London tutorial class, at St. Bartholomew's Hospital. No small part of my organic chemistry (1874) was ingested into him; how much he eventually digested I will not say. Among medical men he has always appealed to me by the clearness of his scientific outlook and entire absence of pose. It is interesting to compare training such as he had with the present. Except anatomy, no preliminary subject was then taught practically. A beginning had been made, in physiology, at University College and we know that Michael Foster introduced the subject at Cambridge in 1876; yet Lauder Brunton and I, already in 1868-69, had attended a wonderful lecture course by Ludwig, in Leipzig, which was minutely experimental from beginning to end and, as a consequence, unforgettable. Idealists have made such teaching impossible here to-day.

H. E. A.

DR. J. J. CARTY

DR. J. J. CARTY, for many years connected with the Bell Telephone System in America, died on December 27 at the age of seventy-one. He had retired from active service in 1930. Carty played a great part in the development of electrical communication, and was probably as instrumental as any one man in the creation of the present-day American telephone system, which involves some twenty million stations and eighty million miles of wires.

Carty was appointed chief engineer of the New York Telephone Company at a time when the problem of placing exchange wires underground was pressing for a solution, and he guided the successful development of the lead-covered paper-insulated cable. Later he became chief engineer of the American Telephone and Telegraph Company, and in this capacity he carried through to successful conclusion the building of the first transcontinental telephone lines in 1914–15, including the adaptation of the vacuum tube amplifier to the telephone repeater. Later in the same year he was able to announce the bridging of the Atlantic Ocean by radio telephone. He was also instrumental in the development of lead-covered cables for long distance telephony, the first undertaking of this kind being the Boston-Washington toll cable of large gauge wire which was placed in operation in 1913. This was followed by the New York–Chicago toll cable, the first to use small gauge wire, in 1921.

Dr. Carty was a member of the National Research Council of America, and a member of council of the National Academy of Sciences of the United States. In 1915 he was elected president of the American Institute of Electrical Engineers. In 1903 he was awarded the Longstreth medal and, in 1916, the Franklin medal of the Franklin Institute; and in 1918, the Edison medal of the American Institute of Electrical Engineers.

To those who worked for him, Dr. Carty will be as much remembered for his inspiring leadership as for his deep knowledge of electrical communication.

PROF. A. M. STALKER

ALEXANDER MITCHELL STALKER, who died in Dundee on December 23, was born in Leven in 1853. After an arts course from which he graduated with first-class honours in mental philosophy, he entered on the study of medicine and after graduating at Edinburgh he studied also at Leipzig.

Ultimately he started practice in Dundee, where he was soon appointed physician to the Royal Infirmary. Distinguished not only by his clinical skill but also by his wide philosophic outlook, he became a leader in a group of younger men who were raising medicine in Dundee to the academic standard that fitted it, when the time was ripe, to furnish the Medical School of the University of St. Andrews.

In 1898 Stalker was with universal approval appointed the first professor of medicine in the new School and grasped whole-heartedly the opportunities afforded of service to medical education in the training of his students. His aim throughout was to lay clearly the main lines on which medical knowledge could be interpreted and applied. In this he was singularly successful, while at the same time he imbued his pupils with an enthusiastic curiosity that encouraged them to track to its place anything which they might encounter outside the range of their previous experience.

Prof. Stalker was endowed with an unusual memory and, widely read, not only in philosophy but also in general history and literature, he was able by accurate reference to keep medicine in touch with the general body of knowledge. Though a good writer and a fine lecturer, his publications were limited to occasional papers, in the interests of his routine duties as physician and teacher. In 1924, when he retired, the University in recognition of his services conferred on him the degree of LL.D.

MR. G. R. CARLINE

GEORGE REGINALD CARLINE, who died in London on December 24 at the age of forty-seven years, succeeded the late H. Ling Roth as keeper of the Bankfield Museum, Halifax, in 1924. He continued the work of his predecessor in adding to the collections of the Museum illustrating the development of the primitive loom and weaving technique. Formerly he had been assistant curator to the Wellcome Historical Medical Museum, London, and afterwards at the Pitt-Rivers Museum, Oxford. In 1929 he accompanied the British Association to South Africa, contributing to the proceedings of Section H (Anthropology) a paper on the handloom in Africa, and afterwards spending some time in observation among the Mambwe tribe of Northern Rhodesia. He had excavated with Sir Flinders Petrie in the Fayum in 1925 and was closely associated with the work of the Folk-Lore Society and the Royal Anthropological Institute, and was a contributor to their journals.

WE regret to announce the following deaths:

Mr. Cecil Fowler Beadles, curator of the Pathological Department of the Museum of the Royal College of Surgeons, on January 3, aged sixty-six years.

Prof. Robert Donaldson, Sir William Dunn professor of pathology in the University of London, on January 3, aged fifty-five years.

Dr. Malcolm Evan MacGregor, director of the Wellcome Entomological Field Laboratory, of the Wellcome Research Institution, who has done much work in connexion with malaria, on January 12, aged forty-three years.

Mr. J. L. S. Hatton, Vice-Chancellor of the University of London, and first principal of East London College, on January 13, aged sixty-seven years.

Sir Robert Jones, K.B.E., president of the Association of Surgeons of Great Britain and, in 1921–25, president of the British Orthopædic Association, on January 14, aged seventy-four years.

Mr. Basil H. Soulsby, formerly librarian of the British Museum (Natural History), on January 14, aged sixty-eight years.

Prof. C. M. Thompson, emeritus professor of chemistry in the University College of South Wales and Monmouthshire, on January 4, aged seventy-seven years.

News and Views

Sir Edward Sharpey-Schafer, F.R.S.

SIR EDWARD SHARPEY-SCHAFER, who will retire from the chair of physiology in the University of Edinburgh at the end of next September, went to Edinburgh in 1899 from the Jodrell chair of physiology in University College, London. He has administered an important department and lectured to large classes of medical students, but he has also had abundant energy left to devote to his numerous investigations, which have extended over a wide field including general histology, the endocrine organs, the nervous system, the pulmonary circulation and artificial respiration. His published books include his masterly work on the endocrine organs and his well-known "Essentials of Histology", which has passed through seven editions since its author went to Edinburgh. The feature of Sir Edward's work in the University of Edinburgh has been his emphasis on, and his encouragement of, research. In his eighty-third year, he is still active and acute in mind, and as keen and assiduous as ever in the prosecution of research. His retirement from the chair will remove one of the best-known figures in the University Medical School and the senior member of the Faculty of Medicine.

APPRECIATIVE reference should also be made to Sir Edward's services, outside his University duties, for example, as founder in 1908 of the *Quarterly Journal of Experimental Physiology*, which he has edited throughout its existence, and to his continued interest in the Physiological Society, of which he is now the only remaining founder member. Of his more general services to science may be noted his work as general secretary of the British Association (1895–1900) and as president of the Dundee meeting in 1912, and his presidency of the Royal Society of Edinburgh since 1929. Sir Edward was elected a fellow of the Royal Society of London so long ago as 1878. He received a Royal medal in 1902 "for his researches into the functions and minute structure of the central nervous system, especially with regard to the motor and sensory functions of the cortex of the brain", while in 1924 he was awarded the Society's supreme honour, the Copley medal. In making the presentation of the Copley medal, Sir Charles Sherrington described Sir Edward's fundamental work on the adrenal and pituitary glands as opening up a modern chapter of physiological knowledge with important consequences for medical studies and treatment.

China and American Scientific Expeditions

BY favour of Dr. Henry Fairfield Osborn, president of the American Museum of Natural History, we have received a copy of his reply to the communication from the Chinese National Committee for the Preservation of Antiquities in reference to the Museum's expedition to Inner Mongolia and the rupture in the relations for scientific co-operation between the Museum and Chinese scientific men (see NATURE, 130, 803, Nov. 26, 1932). In his reply Dr. Osborn points out that the American expedition has worked under an agreement made in 1921 whereby, provided its operations were confined to regions where the Geological Survey of China could not work, it was to be unhampered in Mongolia; but, he maintains, the Geological Survey has not adhered to its part of the bargain. In 1928 the expedition's collections were detained at Kalgan for six weeks, without legal or moral right; and the expedition was charged with possessing only "hunting permits", although the permits were the same as in preceding years and the character of the work on which the expedition was engaged was universally known. In 1929 the expedition was not allowed to proceed in the field as the demands made by the Chinese commission were "exorbitant and without international precedent".

IN the Chinese communication, it will be remembered, stress was laid on the fact that Dr. Andrews had assured the commission that the expedition of 1930 was to be the last of the series, but that in 1931 he had applied for a permit for further work in Mongolia. Here Dr. Osborn states that further work had been made necessary by the discoveries of the expedition in 1930 and the negotiations were opened at his request; yet Dr. Andrews was not even given an interview. He then deals with the termination of the Museum's work in China and the transfer of its activities to Manchukuo, a decision which was reached after mature deliberation. Further, he points out, the closure of the Museum headquarters at Peking by Dr. Andrews was not unauthorised, as has been suggested, but was effected with full authority as the officer of the Museum in charge of exploration and under direction. In expressing the regret of the American Museum that the friendly relations between Chinese scientific men and the American Museum, which existed until 1928, should be thus severed, Dr. Osborne feels that it is through no fault on the side of the Museum. Dr. Andrews insisted on the privilege of completing the work in Mongolia under the agreement of 1921. This made him unpopular with the commission, but no other course was open to him. Dr. Osborn concludes, "It is difficult to see how it would be profitable for this Museum to conduct field work under any other conditions."

Technocracy

RECENTLY in the United States the new economic doctrine of 'Technocracy' has aroused much attention and provoked much discussion. This movement has been sponsored by a number of engineers and scientific workers, and according to an article in the *Times* on January 5, its underlying thesis is that the tremendous technological advance made in industrial processes during the past century and particularly during the past twenty-five years has rendered all existing social and economic mechanism obsolete and futile. 'Technocracy' claims that scientific discovery and modern engineering skill have now armed mankind with powers that would ensure leisure and plenty for all if only they were properly employed. It asserts that the basic factor in social life is the amount of energy available for productive purposes and that no solution is possible so long as the present price system is retained. Energy, according to the exponents of 'technocracy', is the real measure of human labour and human wealth and therefore real prosperity will only be obtained when individualism is discarded and an entirely new system of distribution based on 'energy certificates' instituted. At present, however, as the *Times* article states, the highly technical language in which most of its statements are shrouded make certain aspects of the theory obscure while others could be refuted by any economist without difficulty. The lines of research and the deductions drawn from the assembled facts are obviously the work of engineers thinking in terms of mechanical production and ignoring all considerations of human psychology.

British Industries Fair

THE 1933 British Industries Fair, which opens on February 20 and continues until March 3, will be held, as last year, at Olympia and the White City in London, and at Castle Bromwich in Birmingham. It still goes on expanding. This year the Fair will be bigger, the exhibits more varied and the exhibitors more numerous than ever before. What is perhaps of more importance is that all indications up to the present point to the probability of a great increase in the number of buyers who will attend. For example, the acceptances by overseas buyers of invitations issued by the Department of Overseas

Trade, which organises the Fair, are already 30 per cent more numerous than those received last year. Sixteen European countries, as compared with only five countries last year, are providing special travelling facilities at reduced rates to encourage their buyers to attend the Fair. Altogether some fifty-six different countries and territories will be thus represented. The Fair may be expected to show in what ways and to what extent British manufacturers have availed themselves of the competitive advantages obtained through Britain's abandonment of the gold standard and as a result of the Ottawa Conference. We hope to deal with scientific aspects of the Fair at a later date, but it is satisfactory to note now that scientific and optical instrument makers will be well represented.

Association of British Zoologists

DR. J. GRAY was in the chair as president at the annual meeting of the Association of British Zoologists, which was held in the rooms of the Zoological Society on Saturday, January 7. The morning session was given to discussion of several motions concerning the teaching of biology. It was moved by Prof. E. W. MacBride that vacation revision courses at the universities are highly desirable for teachers of science in schools. This motion was supported by several speakers, but the danger that such courses should be considered sufficient substitute for previous training in the sciences which the teacher was expected to teach was emphasised by Prof. W. Garstang and Prof. Graham Cannon. Mr. H. R. Hewer gave an account of the proceedings of the recent National Conference on the Place of Biology in Education. It was suggested by Prof. Douglas Laurie and Prof. J. S. Huxley that in elementary education a general scientific course is required rather than one in which the scientific subjects are separately organised, but that in such a general course biology must have a leading part. A discussion on the best way of influencing the teaching of biology in schools was introduced by Prof. Graham Cannon. He suggested that this could best be done through the examination boards of the country and in this was supported by Dr. Philippa Esdaile. The president suggested that many of the present difficulties are due to the absence of any body with the function of correlating school and university teaching.

DR. GRAY spoke on "The Importance of Zoological Advice to the State". He said that although the supply of biologists has greatly increased in recent years, there is still great difficulty in persuading good students to undertake work in Government employ. He considers this is partly due to the absence of liaison between the teachers at the universities and those who would later employ the biologists. Some body which could undertake the maintenance of this liaison would be useful. In the afternoon, Mr. W. B. Alexander spoke on the conduct of British ornithological surveys and mentioned the proposed founding of an Institute of Ornithology to deal with such subjects. Several speakers joined in the discussion of a motion introduced by Prof. F. Balfour Browne concerning the confusion in systematic zoology which results at present from the frequent change of zoological names necessitated by the strict application of the law of priority to them and from the small number of *nomina conservanda* which the International Commission on Nomenclature is able to set up. It was agreed by 23 votes to 3 "that British zoologists should at once set about making a list of proposed *nomina conservanda*, and that to this end a committee of zoologists should be constituted".

Earthquake in the North of England

AN earthquake, rather strong for England, occurred at about 8.30 A.M. on January 14. It has been suggested that it was one of the numerous earth-shakes felt along the Irwell Valley fault near Manchester rather than a genuine earthquake. It differed, however, both in intensity and disturbed area from these local shocks, the strongest of which so far known (that of November 25, 1905) only attained the degree 7 (Rossi-Forel scale) and disturbed an area of 144 square miles. So far as we can judge from the early reports, the earthquake of January 14 was strongest in and near Wensleydale, so that it may have been connected with the well-known Craven fault. At Hawes and the neighbouring village of Bainbridge, a few field-walls and chimney-pots were thrown down. The shock was felt over a wide area, from the Point of Ayre lighthouse in the Isle of Man to Whitby and Bridlington, as well as at Manchester, Altrincham, etc. The disturbed area must thus contain about 25,000 square miles. The earthquake was recorded at Stonyhurst and West Bromwich, but not at Kew Observatory.

Recent Chinese Earthquake

A VERY severe earthquake occurred in north-west China on December 25. From records at nine widely distributed observatories, the U.S. Coast and Geodetic Survey places the epicentre in lat. 40° N., long. 98° E. (Wire Report of Science Service, Washington, D.C., Dec. 27.) This point lies between the towns of Su-chow and An-hsi-chow, near the edge of the Gobi desert, about 300 miles north-west of the epicentre of the great earthquake of 1927. The earthquake must have been very destructive, but, owing to the isolation of the district, weeks may elapse before accounts arrive from the central area.

The Institute for Advanced Study

THE Institute for Advanced Study in the United States was founded in 1930 by a grant of 5,000,000 dollars from Louis Bamberger and Mrs. Felix Fuld. Dr. Abraham Flexner, director of the Institute, has announced that it will be opened in the autumn of 1933, and will be housed temporarily in Fine Hall, the graduate mathematics building at Princeton University. Prof. Albert Einstein has accepted a life appointment as head of the Institute's School of Mathematics. Prof. Einstein will make his home at Princeton; he will be in residence at the

Institute annually from October 1 until April 15, beginning next autumn, and will make a yearly visit to Germany. He will devote all his time to the Institute, and his trips abroad will be vacation periods at his summer home outside Berlin. The following appointments have also been made: Dr. Walter Mayer, of Berlin, Prof. Einstein's assistant, to be associate in mathematics; Prof. Oswald Veblen, generally recognised as one of the leading American mathematicians, and at present professor of mathematics in Princeton University, to be professor; Dr. J. L. Vanderslice, a young Princeton graduate student who has been Prof. Veblen's assistant at Princeton, to be his assistant at the Institute.

THE Institute will be unique among American institutions of higher education, being based upon ideas designed to make it 'a scholar's paradise'. It will concentrate its aim exclusively upon quality in the selection of its teachers and students, and in the nature of its work in scholarship and research. It is hoped that the Institute will accomplish certain definite things in setting a new trend in higher education in America. The salaries paid to its staff and faculty will be on such a scale as to show how much greater results may be obtained when teachers are freed from the necessity of seeking additional remuneration outside the university, and the entire staff of professors and assistants will be on the full-time basis of employment. More emphasis will be laid upon the individual among university graduates, and it is expected to attract students of an independent turn of mind. In order to further this aim of individualism, the Institute will remain entirely separate from any conventional university or college conception. Dr. Flexner makes it clear that while the Institute will occupy temporary space in a Princeton building, it will not be a part of Princeton University. The Institute will consist of a series of schools the first of which will be the School of Mathematics; the second, it is hoped, will be a School of Economics and History. It will be exclusively post-graduate.

'Ethnogenics'

CAPT. GEORGE PITT-RIVERS has published in amplified form (*Human Biology*, vol. 4, No. 2) an address originally given before the Section H (Anthropology) of the British Association, in which he coins the term 'ethnogenics' for "the study of those forces, amenable to social control, which may influence the fertility and survival rate of variations of type in a population". He discusses the early history of anthropology, its long period of infancy as a science, and the reasons why anthropologists continue to regard it as an infant science. This appears to arise from a failure to agree about the scope of anthropology or as to how its subject matter should be classified. The view is emphasised that the progress of anthropology depends on a re-synthesis of its various branches, biological and cultural, including eugenics, genetics, demography, population questions and psychology. The conceptions of race, population and culture as the tripartite aspects of man in time, conditioning and being conditioned by the environment—all are included in the implications of race-population change or ethnogenics. The need for studies of racial, social and economic disintegration among civilised as well as primitive peoples is emphasised.

Expedition to Northern Iraq

THE departure is announced of a joint expedition of the British Museum and the British School of Archæology in Iraq (Gertrude Bell memorial) to conduct excavations at Arpachiyah, on the upper Tigris, four miles east of Nineveh. The expedition will be under the direction of Mr. M. E. L. Mallowan, who was with Dr. R. Campbell-Thompson at Nineveh last year. The choice of site has been determined by the fact that it is the only known prehistoric site in northern Mesopotamia. The investigation on which Mr. Mallowan was engaged last year on the neighbouring site of Nineveh reached virgin soil at a depth of 92 ft., of which 72 ft. was prehistoric material, and revealed evidence of five stages of culture, ranging in date from about 3000 B.C. (Stage 5) to about 5000 B.C., polychrome pottery being found in Stage 2, which in its earliest form showed affinities with Samarra ware. At Arpachiyah evidence of culture comparable with that from the archaic levels at Ur, Kish and Erech has been found and the surface finds are similar to material from the bottom of a pit at Nineveh. It may, therefore, be expected with some confidence that excavation at Arpachiyah will yield evidence which will much enlarge knowledge of the very early periods of civilisation in northern Mesopotamia.

Spike Disease in Indian Sandal

AN editorial article in the September number of the *Indian Forester* (vol. 43) deals with progress in forestry research. The writer commences by directing attention to the report of the seventh Spike Conference (reproduced in this number). It is more than thirty years since the first attempts to study the spike disease of sandal were made. Sandal is one of the major forest products throughout southern India, and the value of the trade in this precious timber amounts to 30–40 lakhs of rupees annually, apart from the market value of the sandalwood oil. Most of the sandal-bearing forests are affected by the spike disease, the presence of which reduces the sandal output by about half, and in many places has killed out valuable crops. So far, in spite of the close study made, no cure has been found and the issue is complicated owing to the sandal being itself a parasite and unable to flourish without some other tree species as a host. The various governments affected have combined in the research work which is now being conducted on an intensive scale. Spike disease of sandal is but one out of many problems which await the investigator in Indian forest research. The Government forest estate alone covers an area of 160,000,000 acres; the forest area in the Indian States covers 45,000,000 acres; whilst in addition there is an even larger area of private and village forest lands. Probably about half of the 160 million acres of forests under the control of the Indian Forest Department are commercially productive, the other half being conserved for the use of right holders or serving as purely 'protection forests'. In spite of this, the revenue has risen from 70 lakhs (a surplus of 17 lakhs) in 1870 to 6 crores of rupees (surplus 2½ crores) in 1930. Research has, so far, cost Rs. 3·6 per square mile, as against a surplus of Rs. 105 per square mile.

Agricultural Research in Great Britain

The report on the agricultural research work carried out in Great Britain with the aid of State funds during the year 1930–31 has now been published by the Ministry of Agriculture (London: H.M. Stationery Office, 1932). The volume, which aims at presenting in convenient form the progress made at the various research institutes and other centres in Great Britain, is planned on the same lines as that issued in the preceding year, with the additional feature of a list, at the end of each report, of papers published during the year by the institute or research centre in question. References to the papers will be found in the text, and the lists will take the place of the annual volumes of "Abstracts of Papers on Agricultural Research in the United Kingdom", the publication of which has been discontinued. It is evident that many important results have been obtained in a number of branches of the subject, but the investigations are too numerous and cover too wide a field to allow of even brief reference being made to them individually. Those desiring further information regarding any subject dealt with in the reports are invited to communicate with the director or other persons concerned, for which purpose a list of names and addresses of directors of research institutes and persons in charge of investigations at other centres is given in the appendix.

High Pressure Boilers

A paper on high pressure boilers read to the Institution of Electrical Engineers on December 15 by C. H. Davy and C. H. Sparks gives an interesting account of the development of the use of very high pressure steam in modern boilers. Prior to 1918, no plants had been placed in commercial service with steam pressures exceeding 350 lb. per sq. in. In 1923 the Edison Company at Boston ordered the first boiler unit suitable for a pressure of 1,200 lb. per sq. in. The construction of this boiler was made possible by the use of the first seamless forged steel boiler drum. Recent developments of X-ray technology have given the manufacturer of welded drums the long sought non-destructive test. A definite proof of the satisfactory condition of a metallic arc fusion weld can now be given by radiographic examination. By means of scientifically controlled welding, drums can be produced which are more suitable for working conditions than the riveted structures used in the past. The drums forming part of the 1,400 lb. per sq. in. pressure sectional boilers at present being installed at the Dagenham plant of the Ford Motor Co. are 45 ft. long, 48 in. in internal diameter, 5 in. thick and weigh 62 tons. The production of such forgings reflects great credit on the forge-masters. Whilst the trend of invention has been definitely towards higher final steam temperatures, it is probable that these will be limited, at least for the present, to below 850° F. This is due to the fact that the cost of 'special' steels is still very high and so it is not economical to use them. The Philip Carey Works at Ohio, which started last year, use a steam pressure of 1,800 lb. per sq. in. The demand for high pressures and consequently high temperatures continues for power stations but super-pressure boilers are mainly used in industrial work.

Map of East Greenland

A new map on a scale of 1 : 200,000 of the coastlands of East Greenland between Sofia Sound in about lat. 73° N. and Young Sound in about lat. 74° 10′ N. based on surveys by Norwegian expeditions in 1929 and 1931 has been published by Norges Svalbard og Ishavs-Undersökelser. This includes the coasts to the north and south of the Norwegian meteorological observatory at Myggbukta in Mackenzie Bay in lat. 73° 29′ N., long. 21° 34′ W. This coast was first sighted by Hudson in 1607 and has since been explored by various expeditions, including those of Clavering in 1823, Nathorst in 1899 and in the north by Wordie in 1926. While much detail is still omitted, the new chart shows many advances on previous ones.

Anti-Veterinary Propaganda

In the autumn issue of *The Fight Against Disease*, the quarterly journal of the Research Defence Society, attention is directed to the attacks which anti-vivisectionists, and notably the National Anti-vivisection Society, have made and persist in making on the Royal Veterinary College and on any other organisation which helps to further veterinary science, with attempts to divert funds from the Tail Wagger's Club. In regard to the last named, the governors of the College have stated that no part of the funds or income arising therefrom is applied in vivisectional experiments. Prof. F. T. G. Hobday, whose name appeared in the New Year honours list as the recipient of a knighthood, the principal of the Royal Veterinary College, in the recent Alexander Pedler Lecture of the British Science Guild (British Science Guild, 6 John Street, London, W.C.2. 1*s*.), also emphasises the humane side of veterinary practice for the animals themselves, and declares our deep and heavy responsibility in ensuring that we act humanely towards the animals in our charge.

Collecting and Preserving Worms

A useful guide for the collector, No. 12 of the British Museum (Natural History) series of "Instructions for Collectors", deals with the various groups of worms. Short descriptions and illustrations are given of the characteristic features of the main groups, with hints as to the places where they are likely to be found. But the most serviceable features are the precise instructions for collecting worms, free and parasitic, and for anæsthetising and preserving them. The pamphlet, of 22 pages, is sold at the British Museum (Natural History) at *6d.*

Ultra-Violet Light at British Health Resorts

FIGURES of the amount of ultra-violet light enjoyed by thirty-two British health resorts during the summer months, July, August, and September, are given in *Sunlight* (vol. 2, No. 7, p. 209). St. Ives heads the list with a daily average of 6·6 'units', and none had less than 1·3 units. Half a unit is sufficient to cause perceptible sunburn.

Spring Lectures at the Royal Institution

THE session of public afternoon lectures at the Royal Institution was opened by Prof. J. C. McLennan, who is giving an experimental course on the work on "Low Temperatures and Low Temperature Phenomena" with which he and the University of Toronto have been specially identified. A course on "Recent Advances in Genetics" is to be given by Prof. J. B. S. Haldane, who has recently returned from a visit to the laboratories at the University of California and elsewhere in the United States. Later courses are by Sir William Bragg, who will review the progress in the past twenty years of the science of crystal analysis by X-rays; and Mr. A. R. Hinks, secretary of the Royal Geographical Society, on "Geography in the Public Service". Mr. Hinks will speak on the new one inch Ordnance Survey map, and the delimitation of national boundaries. Lord Rutherford will give a Saturday course on the "Detection and Production of Swift Particles". The course will be experimental, and as a part of his subject Lord Rutherford will describe the recent progress at the Cavendish Laboratory by Chadwick, Cockroft and Walton and others. Sir James Jeans will give a course on "Modern Astronomy". The new Fullerian professor of physiology at the Royal Institution, Prof. G. Elliot Smith, will give a course on the "Evolution of the Mind". The session will conclude with a display of films, entitled "Developments in Cinematography". Instructional films, colour films, and films in relation to aeronautical research will be shown.

Announcements

AT a meeting of the Harrison Memorial Prize Selection Committee on January 13, the Harrison prize for 1932 was awarded to Dr. H. J. Emeléus, of the Imperial College of Science, London.

THE Gold Medal of the Royal Astronomical Society has been awarded this year to Dr. V. M. Slipher, director of the Lowell Observatory, for his spectroscopic researches on planets, stars and nebulæ. Dr. Slipher has been invited to deliver the George Darwin Lecture for 1933. At the annual general meeting of the Society on February 10, the president, Dr. H. Knox-Shaw, will deliver an address on "The Distances and Motions of the Extra-Galactic Nebulæ".

THE following have been appointed to the Safety in Mines Research Board: Dr. C. V. Drysdale, director of Scientific Research at the Admiralty, Mr. F. Edmond, chief mining agent to the Wigan Coal Corporation, Ltd., and Major H. M. Hudspeth, chief mining engineer to the Board. The appointment of Prof. J. F. Thorpe would normally have ended on December 31 last, but Prof. Thorpe has accepted a special extension of his term of service for a period of two years. Prof. C. H. Lees, whose appointment was specially extended at the end of 1931, has now completed his term of service.

DR. R. R. MARETT, Rector of Exeter College, Oxford, has been appointed Donnellan lecturer for 1933 in Trinity College, Dublin. The lecture will probably be delivered in the second week in May. An earlier date than usual is being arranged to suit Dr. Marett's other engagements. He has announced the subject of the lecture as "Pre-theological Religion in Feeling, Thought and Action".

A COURSE of four public lectures entitled "An Introduction to Indian Archæology" will be given by Mr. F. J. Richards, honorary lecturer in Indian archæology at University College, London, beginning on Tuesday, January 24, at 5.30 P.M., and thereafter at the same time on each Tuesday until February 14. The subjects of the lectures will be: physical factors; human factors; religious complexities; arts, useful and otherwise. The lectures are open and the public will be admitted without fee or ticket.

BY arrangement with the Polytechnic, Regent Street, London, and the National Illumination Committee and the Illuminating Engineering Society, a course of ten lectures on illumination will be given at the Polytechnic on Wednesdays beginning February 8. The lectures will deal with various aspects of illumination and will be delivered by experts in the respective subjects. Further information can be obtained from the Director of Education, The Polytechnic, 309 Regent Street, W.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A wholetime abstractor and translator (at Sheffield) for the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Cromwell House, Dean Stanley Street, Millbank, London, S.W.1 (Feb. 4). A public and agricultural analyst and gas examiner for the County of Derbyshire—The Clerk to the County Council, County Offices, Derby (Feb. 4). A librarian for the Halesowen Urban District Council—The Clerk, Cornbow House, Halesowen (Feb. 10). A specialist in biochemistry and physiology in relation to food and nutrition on the medical staff of the Ministry of Health—The Director of Establishments, Ministry of Health, Whitehall, S.W. (Feb. 13). A metropolitan meat industry commissioner for the Government of New South Wales—The Minister for Public Works and Health, Department of Public Health, Sydney, Australia (March 31).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Characteristics of Highly Active Vitamin A

THE recent publications of Karrer, Morf and Schöpp[1], and of Heilbron, Heslop, Morton, Webster, Rea and Drummond[2], have pointed to the conclusion that the highest concentrations of vitamin A they were able to obtain were almost pure. We have recently been able, by the help of high-vacuum technique, to prepare a much more highly active vitamin A. The physical data relating to our preparation are recorded below.

For the final stages of purification a pumping system with a limiting pressure of 10^{-7} mm. was employed, and the vacuum was of the order of 10^{-5} mm. The conditions of distillation were such as to secure vaporisation with as small a path of traverse as possible for the molecules from the evaporation surface to the condensation surface, the mean distance being 12 mm. for an evaporation area of 30 sq. cm. Provision was made to regulate the heat input so that the end point of distillation of the various fractions might be as sharp as possible, a temperature advance equal to about 5°–7° C. being necessary to bring about the commencement of distillation of the next higher fraction after removal of the main fraction. By this means it was possible to effect separative distillation over a range of temperatures between 115° and 170° C. The fraction boiling between 136° and 137° C. gave physical constants and figures on analysis which lead to the conclusion that the substance is a purer vitamin A preparation than has hitherto been described. They are as follows :—

The antimony trichloride blue value is 78,000.

Spectroscopic figures :

(1) From the colour produced with antimony trichloride

$E \left\{ \begin{matrix} 1 \text{ per cent} \\ 1 \text{ cm.} \end{matrix} \right.$	693 mμ.	465
	617 mμ.	5,000
	580 mμ.	2,600

(2) Direct spectrophotographic measurement :

$E \left\{ \begin{matrix} 1 \text{ per cent} \\ 1 \text{ cm.} \end{matrix} \right.$	328 mμ.	1,600

The figures for the purest vitamin A previously obtained by Heilbron and his colleagues were: Antimony trichloride blue value of 65,000.

(1)	$E \left\{ \begin{matrix} 1 \text{ per cent} \\ 1 \text{ cm.} \end{matrix} \right.$	693 mμ.	450
		617 mμ.	4,650
		580 mμ.	2,550
(2)	$E \left\{ \begin{matrix} 1 \text{ per cent} \\ 1 \text{ cm.} \end{matrix} \right.$	328 mμ.	1,370

Ultimate analysis gave the following figures: $C = 83 \cdot 5$ per cent, $H = 10 \cdot 6$ per cent, which are in excellent agreement with the formula suggested by Karrer, $C_{20}H_{30}O$, requiring $C = 83 \cdot 9$ per cent, $H = 10 \cdot 5$ per cent. It has also been found that the product in alcoholic solution shows no optical rotation.

The biological test showed that 0·0006 mgm. a day administered to rats gave slightly better growth than 0·001 mgm. (or 1 unit) a day of International Standard Carotene. This dose sufficed to cure xerophthalmia.

We desire to express our thanks to Miss K. Culhane for the biological test and to Prof. Heilbron and Dr. Morton for much help with the analysis and physical determinations.

FRANCIS H. CARR.
WILLIAM JEWELL.

The British Drug Houses, Ltd.,
Graham Street, London, N.1.
Jan. 10.

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[1] *Helv. Chim. Acta*, **14**, 1431.
[2] *Biochem. J.*, **26**, 1178.

Irradiation of Nucleic Acids and Uracil

GUHA and Chakravorty[1] recently announced the formation of vitamin B_1 by the ultra-violet irradiation of adenine sulphate. We wish to report similar experiments with nucleic acids and uracil.

Studies of the relation of the constituents of the cell nucleus to the effects of ultra-violet light on cells led us to examine the absorption changes of these materials upon irradiation with various ultra-violet wave bands[2]. In the course of these investigations, we were struck by the fact that modifications of the spectra of these materials upon irradiation—more particularly if wave-lengths shorter than 2900 A. were excluded—brought them into close resemblance to the spectra of certain B_1 concentrates[3]. The similarity of the sources of B_1 and these materials, and the observation that uracil and adenine acquire the ability upon irradiation of reducing arsenophosphotungstate solutions[3]—a colour test held by some to be a property of vitamin B_1—suggested that B_1 might be a modified purine or pyrimidine of the type produced by the irradiation of such materials.

In most of the experiments by which we undertook to test this hypothesis, thymus and yeast nucleic acids were used, since, as each contains four nitrogen bases, any activation of either or all of these to any or several of the components of the vitamin B complex might, we thought, be so secured. The injection of irradiated nucleic acids into polyneuritic rats appeared in some instances to indicate moderate vitamin B_1 activity. Indeed, one apparent cure resulted from the administration of irradiated uracil. But careful examination of the results with large numbers of animals made it appear that the positive effects should be attributed to variability of the rats, and it was necessary to conclude that ultra-violet irradiation was probably ineffective in producing vitamin B_1 from these substances. Our irradiated materials were also tested for vitamin B_2 potency, with negative results. A paper by one of us describing these experiments is now in press[4].

The negative results are borne out by the fact that our more recent spectrographic work[5,6] indicates vitamin B_1 to be characterised by a maximum at 2600 A., whereas the absorption changes believed at first to be associated with the production of vitamin B_1 were mainly in the shorter wave region[2]. Our studies of the absorption spectrum of irradiated adenine sulphate[2] show it to be less, rather than more, similar to what we now believe to be the characteristic spectrum of vitamin B_1[5,6].

The reported finding of sulphur in the most potent vitamin B_1 concentrates[7], is another factor which now makes it seem unlikely that any sulphur-free base could yield vitamin B_1 upon irradiation. That irradiation could introduce sulphur as an integral part of the molecule from the sulphuric acid bound by the base appears a very remote possibility.

Aside from these arguments, it is possible that if adenine is the only precursor of vitamin B_1 in the nucleic acids, one might fail to find activity upon irradiating nucleic acids, but succeed in finding it upon irradiating adenine sulphate, either because of the higher concentration of the material capable of activation in adenine sulphate solutions, or because the chemical binding of adenine to other constituents might prevent its activation when a part of the nucleic acid molecule.

FRANCIS F. HEYROTH.
JOHN R. LOOFBOUROW.
Basic Science Research Laboratory,
University of Cincinnati,
Cincinnati, Ohio.
Nov. 30.

[1] NATURE, **130**, 741; 1932.
[2] Heyroth and Loofbourow, *J. Amer. Chem. Soc.*, **53**, 3441; 1931.
[3] Heyroth and Loofbourow, *Bull. Bas. Sci. Res.*, **3**, 237; 1931.
[4] Heyroth, *Bull. Bas. Sci. Res.*, **4**, 119; 1932.
[5] Heyroth and Loofbourow, NATURE, **130**, 773; 1932.
[6] Heyroth and Loofbourow, *Bull. Bas. Sci. Res.*, **4**, 35; 1932.
[7] Windaus, *et al.*, *Z. physiol. Chem.*, **204**, 123; 1932: Kinnersley, O'Brien and Peters, *J. Physiol.*, **76**, 17*P*; 1932.

Meaning of Neoteny and Pædogenesis

FOR a scientific term to be of value it is absolutely necessary that in all circumstances it should be used with strict regard for its definition; otherwise only confusion of thought and faulty argument can result. This should be obvious, but unfortunately some terms readily lend themselves to misuse. 'Pædogenesis' and 'neoteny' are terms the definitions of which have been treated with very scant respect. Because of the confusion that has resulted it seems desirable that attention should be directed both to the origins of these words and to their real significance.

The term 'pædogenesis' was first proposed in 1866 by K. E. von Baer[1] who was writing of the phenomena which had recently been observed in *Miastor*, and it is quite clear that he regarded pædogenesis as a form of parthenogenesis. The fact that von Baer regarded parthenogenesis as a form of asexual reproduction does not affect the definition.

O. Hamann[2] (1891), when he described an Acanthocephalan which became sexually mature in the larval stage, was one of the first to misuse the term 'pædogenesis'. This was noticed by Chun,[3] who when defining 'dissogony' protested against Hamann's use of 'pædogenesis'. It may be noted here that Hamann was the first to propose the idea of evolution taking place on a large scale by means of 'pædogenesis', an idea which in a modified form finds favour with some modern authors, notably Prof. W. Garstang[4] and Mr. G. R. de Beer.[5]

Kollmann[6] was the first to use the term 'neoteny', and he used it to describe the phenomena which had been observed in the Amphibia. He distinguished between 'partial neoteny', which is said to occur when metamorphosis is delayed beyond the normal period, for example, the wintering of certain tadpoles; and 'total neoteny', which is found in the case of the Axolotl, where the animal retains its gills but becomes sexually mature.

'Neoteny' and 'pædogenesis' therefore indicate two distinct phenomena. In 'pædogenesis' a form of parthenogenesis is found, but in 'neoteny' we see a case of normal sexual reproduction. The distinction between the terms is clear cut and is of biological importance.

In re-defining the terms under discussion, Mr. de Beer has disregarded their origins and the definitions of their authors. So he uses 'neoteny' as a wide term which implies an alteration in the rate of development of the germen as compared with that of the somatic tissues: an idea which cannot be brought into line with Kollmann's views. This alteration may be brought about in a number of ways; if by the speeding up of the rate of ripening of the germen, that of the somatic tissues remaining constant, 'pædogenesis' will result, and Mr. de Beer considers that the most perfect cases of this are those of *Miastor* and *Polystomum integerrimum*; if the acceleration has not proceeded so far a case like that of the Axolotl will result. On this view all these cases are different aspects of the same phenomenon.

It is very doubtful whether the matter should be considered in this way; it would appear to be giving the status of a fundamental biological concept to the observed fact that in a few isolated cases in the animal kingdom the normal relation between the rates of ripening of the germen and of the somatic tissues, as judged by observations on the majority of closely related species, has become modified.

That such a state of affairs has been brought about by changes in the external environment is undoubted, and in the case of the Ctenophores described by Chun[7] this is abundantly clear. It is impossible therefore to consider the sporadic occurrence of the early ripening of the germen as more than a fortuitous happening; and it would appear to be of more value to use the words 'pædogenesis' and 'neoteny' to distinguish forms of parthenogenesis and normal sexual reproduction respectively than to combine under them isolated examples having no biological relationship and drawn at random from all over the animal kingdom.

We are thus brought to the conclusion that the cases of the Axolotl, the Ctenophores and the Acanthocephala are cases of 'neoteny', whilst 'pædogenesis' occurs only in the insects; the case of *Polystomum integerrimum*, in which the fusion of gametes is said to occur, must be regarded as 'neoteny' in an hermaphrodite animal.

To those who incline towards the view that evolution on a large scale has taken place by the process of the shortening of the ontogeny, it may be pointed out that in discussions on this subject the older definitions of 'pædogenesis' and 'neoteny' are of great importance, for it is obvious that if the ontogeny were to be shortened in a truly pædogenetic form sexual reproduction would be lost to that species.

In conclusion it must be noted that 'dissogony' must be regarded as a form of 'neoteny', Chun himself having compared the phenomenon which he had observed with the case of the Axolotl, and contrasted it with the phenomena seen in *Miastor*.

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Nov. 17.

[1] *Bull. Acad. Imp. Sci. St. Petersbourg*, T.9.
[2] *Jena. Z. Naturw.*, Bd. 25.
[3] "Festschrift z. siebenzigsten Geburtstage Rudolf Leuckarts". Leipzig.
[4] *Quart. J. Micr. Sci.*, London. Vol. 72, 1929.
[5] "Embryology and Evolution". Oxford, 1930.
[6] *Verh. naturf. Ges. Basel*, Bd. 7.
[7] "Fauna und Flora des Golfes von Neapel". Monographie I, Ctenophoren.

Oxidase of the Crystalline Style

MY observation of the occurrence of an oxidase system in the crystalline style of *Saxidomus giganteus, Paphia staminea* and *Mya arenaria*[1] has been confirmed by Yonge in that of *Ostrea edulis*, but in this case the reaction of the style extract to guiacum was found to be extremely feeble[2].

Recently I have had the opportunity of testing the crystalline styles of three species of oyster (*O. virginica, O. lurida* and *O. gigas*) for oxidase and have found the reaction to guiacum quite marked. There is considerable variation in each case in the activity of extracts made under identical conditions from different batches of crystalline styles, depending, apparently, on the condition of the styles, which is affected very quickly by small changes in environment, but each species has yielded extracts equalling, or exceeding, in oxidase activity those from *Saxidomus giganteus* made in precisely the same way and tested with guiacum.

In addition to those species already mentioned, *Schizotheurus Nuttalli, Cardium corbis* and *Bankia (Xylotrya) setacea* have now been found to contain the oxidase system in their crystalline styles. It is probably of general occurrence in the lamellibranchs.

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Nanaimo, B.C.
Dec. 9.

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[2] Yonge, C. M., *J. Mar. Biol. Assoc.*, N.S., **14**, 369 ; 1926–27.

Nutritional Condition of Sheep and Susceptibility to Stomach Worm

THE important influence of the nutritional condition of the host in resisting worm infestation has been demonstrated by Zimmermann *et alia*[1], Ackert *et alia*[2,3,4] in chickens, Foster and Cort[5,6,7] and Nagoya[8] in dogs, Kobashi[9] and Chandler[10] in rats. The problem is one of supreme importance in sheep, the parasitic infestation of which frequently constitutes a limiting factor in the carrying capacity of pastures. The number of sheep on a farm may be limited by the potential infectivity of the pasture, rather than by the amount of grazing it provides. Since the information derived from the experiments of these workers would appear to have a very important bearing on the control of parasitic gastritis in sheep, an experiment was commenced in the spring of 1932 to determine the degree to which differences in clinical condition produced by nutritional means might affect the degree of parasitic infestation of sheep exposed to an equal chance of infection.

Forty lambs were taken from their dams soon after birth and fed in concrete pens (sawdust used as bedding) on cow's milk, meals and grass cut from pastures which had never been grazed with sheep or cattle. At the age of three months the lambs were divided into two groups of sixteen (eight having died), the two groups being comparable in weight and appearance. One group was given 7–8 lb. of green tares and oats per head daily. The other group received, in addition to the tares and oats, three pints of separated milk and one pound of mixed meals daily. Fæcal examination on three separate occasions showed that no helminth eggs were being passed.

When four months old the lambs were grazed on worm infested pasture. At this period the average weight of the poorly-fed group was 60 lb. and of the well-fed 84 lb. The well-fed group continued to receive 1 lb. a head of meals, but the separated milk was discontinued.

After six weeks grazing the lambs were slaughtered, their fourth stomachs removed intact and the worms counted. The average number of worms in the poorly-fed group was 103, in the well-fed 31. There was a surprising individual variation within each group, the numbers in the poorly-fed group ranging from 0 to 222 and in the well-fed group from 2 to 76. Statistical analysis of the results, kindly undertaken for us by Dr. Tocher, showed that the difference between the two groups was significant and that the chances against the group difference being fortuitous were 1,400 to 1.

It may therefore be deduced that under natural conditions of infection, the nutritional state of the sheep plays a significant part in determining the degree of its susceptibility to stomach worm infestation.

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D. ROBERTSON.

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and
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Aberdeen.

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[1] Zimmermann, N. B., Vincent, L. B., Ackert, J. E., *J. Paras.*, **12**, 164 ; 1926.
[2] Ackert, J. E. and Spindler, L. A., *Amer. J. Hyg.*, **9**, 292 ; 1929.
[3] Ackert, J. E., McIlvaine, M. F. and Crawford, N. Z., *Amer. J. Hyg.*, **13**, 320 ; 1931.
[4] Ackert, J. E. and Nolf, L. O., *Amer. J. Hyg.*, **13**, 337 ; 1931.
[5] Foster, A. O. and Cort, W. W., *Science*, **73**, 681 ; 1931.
[6] Foster, A. O. and Cort, W. W., *Amer. J. Hyg.*, **16**, 241 ; 1932.
[7] Foster, A. O. and Cort, W. W., *Amer. J. Hyg.*, **16**, 582 ; 1932.
[8] Nagoya, T., *Jap. J. Exp. Med.*, **9**, 573, 587, 595, 603 ; 1931.
[9] Kobashi, S., *J. Chosen Med. Assoc.*, **22**, 31 ; 1932.
[10] Chandler, R. C., *Amer. J. Hyg.*, **16**, 750 ; 1932.

Local Lists of Animals

MAY I make a mild protest against the rather derogatory remarks about local lists of animals in the notice of Bolam's "Birds of Northumberland" in NATURE of December 3 (p. 841)? Natural history studies have made great progress in recent years by the methods practised by Mr. Nicholson, Mr. Elton and others, which find expression in the excellent new *Journal of Animal Ecology*. But because the new is very good, it does not follow that the old is bad : the two are surely complementary.

Local lists are the basis of our knowledge of geographical distribution and there is still plenty to be done at that. The facts for the various groups of animals in Britain are certainly not yet fully known ; even when the data must be adequate (for example, Lepidoptera, Coleoptera) they have not been put together as they have for plants and Mollusca and so made generally available. I much hope that before long the Entomological Society and similar bodies will see that this is done ; it will make the interest of internal distribution much more obvious.

The time, too, is just coming when local lists are beginning to have some historical interest ; some things have remained as they were, some have changed, and changes are, I believe, of more than usual interest among the very birds with which the note in NATURE deals.

These considerations concern the benefit of naturalists in general. Local lists are also of great help to the individual who likes going about the country trying to understand what he sees, because they give him some definite object in pursuit of which he picks up all sorts of good knowledge.

It is, I suppose, just a natural human passion to like to have something definite to do, just as it is to find out something which no one else knows. To observe the beetles of the parish of Edvin Loach in a diffuse and general way probably leads nowhere except to an interest in something else; to set out to make a list of them is a defined purpose which will have the stimulus and joy of approximate achievement and be punctuated by exciting discoveries—new to the parish, new to the county, possibly new to Britain. Incidentally, it will lead to the accumulation of a great deal of knowledge of how the local beetles live and breed, and possibly to the differentiation of fresh forms; the list will, of course, be all the better if some of this is incorporated.

Local lists are, in short, one of the classical techniques of natural history in Great Britain; they have been the framework in which much of the best work has been set, and there is, I think, every reason to expect that the method will be equally fruitful in the future. The average naturalist has not generally got very much spare time and he cannot be a trained scientific biologist, but he can and does serve the same ideal to very good effect.

Dec. 10. A. E. BOYCOTT.

Inheritance of Acquired Characters

IN NATURE of October 1, p. 508, is published an interesting communication from A. F. Dufton to the effect that the fathers of eminent persons tend to be older at the time of birth of the eminent (or shall we say pre-eminent?) child than is typical of fathers of children who do not attain eminence. Mr. Dufton's communication is a confirmation on a more extensive scale of a relationship reported by Francis Galton[1], A. H. Yoder[2], and Havilock Ellis[3], in their more limited studies. It is in keeping with the discovery by Minnie L. Steckel[4] of a positive correlation between age of parent and intelligence of child among the school population of Sioux City, Iowa.

In NATURE of October 15, Dr. R. A. Fisher comments upon Mr. Dufton's letter, one of his suggestions being that "A more satisfactory comparison would be between the ages of paternity for eminent persons, and those of their less eminent brothers and sisters". This comparison has been made upon small series by Yoder and by Ellis with conflicting results. Yoder[2] found the distribution of great men in the older as compared with the younger half of the sibship to be 24 to 13. Ellis[3] found a slightly greater frequency of genius in the position of first-born than of genius in the position of last-born (97–67).

There is available, however, more direct evidence of a positive relationship between parent age and intelligence (or between birth order and intelligence, since parent age and birth order are at present inextricably interwoven). In a study[5] of children examined at the Illinois Institute for Juvenile Research there was found to be a definite tendency for later-born children to exceed their earlier born siblings in intelligence quotient. This finding was confirmed by Dr. Steckel[6] in a study of nearly 7,000 children in the school system of Sioux City, Iowa. In both of these studies, comparisons were made only between siblings and in this way any possible distortions resulting from a correlation of intelligence with age of marriage or family size were eliminated. That these findings were not due to an inadequate standardisation of the tests is indicated by the fact that these relationships were still present when test results were re-standardised upon the child populations from which this sibling material was drawn.

While it is entirely possible to explain this relationship by assuming the inheritance of acquired characters, it is, as Dr. Fisher points out, by no means necessary to make this assumption. Parents are apt to be more experienced in child training and in better economic condition when their later children arrive and it is difficult to judge the possible advantage which an older sibling may give to a younger child's intellectual development. If an explanation is to be sought upon the biological level, I personally should be more inclined to seek it in the physiological effects of the prolonged labour and difficult deliveries with their attendant risk of brain damage which are more common with the earlier born children, than in the inheritance of acquired characters.

The question of order of birth in relation to the development of the child has also been discussed at some length by H. E. Jones[7].

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Dec. 10.

[1] Galton, Francis, "Hereditary Genius", Second edition, London: Macmillan, 1892; p. 78.

[2] Yoder, A. H., "The Study of the Boyhood of Great Men", *Ped. Sem.*, **3**, 134–56; 1894.

[3] Ellis, Havelock, "A Study of British Genius". London: Hurst and Blackett, 1904.

[4] Steckel, M. L., "Parental Age and Intelligence of Offspring". *J. Educ. Psychol.*, **22**, 212–220; 1931.

[5] "Order of Birth, Parent-Age, and Intelligence", by L. L. Thurstone and Richard L. Jenkins. Behavior Research Fund Monograph, University of Chicago Press, 1931.

[6] Steckel, M. L., "Intelligence and Birth Order in Family". *J. Soc. Psychol* **1**, 329–344; 1930.

[7] Jones, H. E., "Order of Birth in Relation to Development of Child". Chap. vii, Handbook of Child Psychology published by Carl Murchison, Clarke University Press, Worcester, Mass., 1931.

A Method of Extending the Frequency Range of the Cathode Ray Tube

THE cathode ray tube could be employed on several present-day problems if records could be obtained at somewhat higher frequencies than those obtainable at present. The use of brighter tubes, lenses of wider aperture, faster films and higher film speeds should achieve the required improvement. With regard to lenses, where a cinema lens is used the following arrangement should be found useful:—A long focus collimating lens receives the light from the cathode ray tube and renders the rays parallel. A short focus cinema lens of large aperture receives these parallel rays and focuses them on to the photographic emulsion. The reason for using two lenses in preference to a single lens is that these lenses are usually designed to receive parallel rays, and therefore if they receive rays which are not parallel the definition suffers unless the aperture is reduced. It will be noticed that the collimator is a long focus lens compared with the convergent lens. In consequence a reduced image of the end of the cathode ray tube is formed in the plane of the photographic plate or film.

The advantage of this arrangement is that since the image is smaller than the object, the spot of illumination on the plate is correspondingly smaller than that on the end of the cathode ray tube. Consequently, if the plate is moving at a constant rate at right angles to the deflection of the cathode ray, the precision of observation in the direction of travel will be increased in the same proportion as the size of the spot is diminished. Now the brightness of the spot is also correspondingly increased so that the exposure of any given part of the plate is correspondingly increased. Three alternatives present themselves: (1) to use the usual speed of plate and increase the deflection, in which case the precision of measuring the deflection will be increased in proportion; (2) to increase the speed of the plate, in which case the precision of measuring in the direction of travel is still further increased; (3) to decrease the speed of the plate, in which case it is the precision of measuring the deflection which is increased. These alternatives are summarised for a case in which there was a ten-fold reduction in the size of the image in the following table:

Alternative schemes.	Speed of plate.	Accuracy of measuring deflection.	Accuracy of measuring in direction of motion of plate.
(1)	1	×10	×10
(2)	×10	1	×100
(3)	÷10	×100	1

From a consideration of other cases it is found that the product of the improvements shown in the last two columns is approximately equal to the square of the linear reduction in the size of the image. All the above figures have been calculated on the assumption that the aperture of the lens system at the tube is a constant one. The data given above show that accuracy is improved the more the image is reduced in size by the lens system. A limit to the improvement is set by the grain of the photographic emulsion, by the difficulty of designing lenses of large aperture and adequate definition, and also by inaccuracies present in the optical instrument used for making measurements of the photographic records which are obtained.

With regard to suitable lenses there appears to be a definite need for a special lens for cathode ray work. A lens having a numerical aperture of 0·8 or 0·7, a focal length of 25–50 mm. and adequate definition on the film over an area of 3–5 mm. would be useful, on the lines of a well-corrected microscope substage condenser. The end of the modern cathode ray tube which presents to the lens a convex surface makes the obtaining of good definition difficult. It would be better from the optical point of view for the surface presented to the lens to be concave. This might be done by coating a suitably curved glass surface with the fluorescent material and by placing this inside the bulb of the cathode ray tube.

With regard to the camera, since film speeds between 10 and 100 metres per second will be required, the use of the ordinary spools and gate would present difficulties. A suitable alternative would be a motor-driven drum with the film wound round its circumference. Exposures on film ½–1 m. long could be obtained in this way. A method of exposing such a rapidly rotating film during one revolution only is to drive a worm wheel from the shaft of the film drum, this worm wheel carrying contacts which short circuit the charge on one of the deflector plates of the cathode ray tube. Prior to and subsequent to the short circuit the cathode ray is deflected behind a screen, so that the illuminated spot does not enter the lens. During the temporary short circuit the spot oscillates about its central position and its movements are photographed. With a worm wheel of 20 cm. in circumference driven at one hundredth the speed of the drum the short circuit contacts should be 2 mm. long.

Longer exposures than those given by a single drum rotation could be obtained by winding the film in a spiral round the drum and causing the lens system to move sideways during exposure, so that the image corresponds approximately to the centre of the film during exposure.

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Capacitance Hygroscopy and some of its Applications

BEING myself concerned with the properties of both soil and cotton, I read with particular attention the article on this subject by Dr. Lawrence Balls in NATURE of December 17. I have found it difficult to decide exactly how Dr. Balls considers the moisture content of the soil or cotton bale under test affects his condenser reading. From his opening paragraph one might conclude that he believes the dielectric property of water to be the dominant factor. Later, however, he remarks that "variations of resistance in the unknown capacity can also alter the 'capacitance' readings". An instrument which responds to changes in electrical resistance is influenced by the salt as much as by the moisture content. One responding to the high dielectric constant of water contained in a material would, on the other hand, be most valuable. There are some who might easily be misled into thinking that a dielectric constant is involved merely because condensers are used in the measurement. In view of the statement I have quoted, it appears that Dr. Balls is aware that his apparatus measures the equivalent parallel capacity of the system tested.

Suppose a condenser of capacity C and resistance R were connected in series, and tested, the 'capacitance' would be $C/(1 + R^2\omega^2C^2)$. If, for example, $C = 100\mu\mu F$, and $R = 1,000$ ohms, at a frequency of 2,000 kc., $R^2\omega^2C^2 = 1\cdot66$, and the 'capacitance' measured would be $37\cdot6\mu\mu F$. If R rose to 2,000 ohms without any change in C, the value would be only $13\cdot1\mu\mu F$. The systems investigated by Dr. Balls are, of course, more complex than this; but there is nothing in his article to show that the 'capacitance' changes which he observes are not mainly due to resistance effects.

The matter can easily be settled by finding how sensitive the 'capacitance' readings are to frequency. If, in the simple case taken above, R were so high as 10,000 ohms, $R^2\omega^2C^2$ would be large in comparison with 1, and the 'capacitance' measured would be substantially $1/R^2\omega^2C$. The value obtained would therefore change inversely as the square of the frequency, and would *fall* with *increase* of C.

In more complicated systems the issue is less clear-cut; but in cases where the measured 'capacitance' varies inversely with the frequency raised to a power between 1 and 2, it is not justifiable, when deducing the properties of the material between the electrodes, to assume it to be a non-conducting dielectric. The frequency test is easily applied, and until the results of it are forthcoming, we are not in a position to place a precise interpretation on Dr. Balls' results.

There is one further point that deserves comment. In connexion with his results with soil, Dr. Balls remarks: "Some very complex curves for changes in soil-capacity with change of moisture have recently been published, determined by a compensated bridge method. They contrast very sharply with such simple curves as Fig. 2, which seem to me to be more inherently probable." These "complex curves" were obtained by Mr. G. H. Cashen of this Station, and the reason advanced for setting them aside does not seem to me at all convincing. I am inclined to regard simplicity as a craving of the human mind rather than a reality of Nature. In any event, Dr. Balls could probably learn a lot about what takes place at the surface of the iron hoops of his cotton bales by employing a method of as critical a nature as that used by Mr. Cashen; 'surface' or 'electrode' capacity must certainly enter in here.

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Heights of Nuclear Potential Barriers

As a result of experimental work in the past few years on the artificial disintegration of light nuclei and the nuclear scattering of α-particles, we now have a means of estimating the heights of the potential walls surrounding these nuclei. I have collected the evidence from a variety of sources which can be summarised as below.

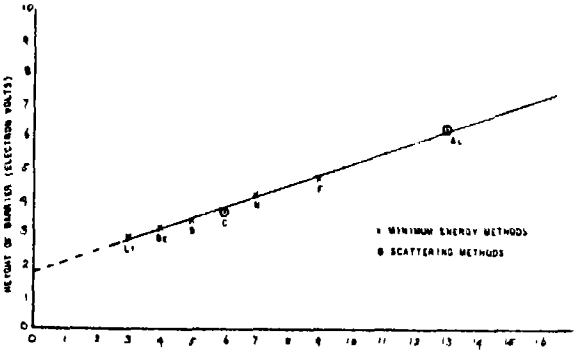

Fig. 1.

(*a*) *Minimum energy methods:* Here the value of the range of the α-particle of least velocity which will enter the nucleus and cause the emission of either a proton or a quantum of radiation is found. The energy of this particle will correspond to the height of the nuclear barrier.

(*b*) *Scattering experiments:* The anomalous scattering of α-particles which make close approach to the nucleus gives a measure of the probability of their entry within. The radius of the nucleus for which this scattering is appreciable can be estimated and from this we can deduce the smallest potential for which an observable penetration takes place: this will correspond to the height found by the minimum energy methods.

The heights so found (given in terms of the potential of an α-particle of charge 2) are plotted against atomic number, giving a straight line (Fig. 1).

This therefore suggests the simple rule that *the heights of the nuclear barriers of the light elements are proportional to the atomic number.*

If this relation is true outside the limits of the elements for which evidence exists, then we must conclude that the protons produced from phosphorus by α-particles from polonium (energy $5 \cdot 2 \times 10^6$ electron volts) and potassium with radium C (energy $7 \cdot 6 \times 10^6$ electron volts) are due to resonance with a virtual α-particle level, since the α-particle will have insufficient energy to surmount the barrier.

The full details of the calculations will be published shortly.

E. C. POLLARD.

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Dec. 12.

Corrections to the Times of the *P* Wave in Earthquakes

A REDISCUSSION of about eighty earthquakes from the International Seismological Summary is in progress. Revised epicentres and apparent times of starting have been found, the revised tables of *P* recently published by one of us being used. The *S* tables were not used because it was known that the identification of *S* is less trustworthy than that of *P*. The new residuals of *P* show that the correction needed at distances near 30° is somewhat larger than was found before. In East European and North American earthquakes the tables seem accurate to 15°, but need a correction rising to + 1s. at 19°. Then there is a sharp bend in the curve, the corrections needed reaching − 5s. about 30°. They remain negative to 58°, and then are positive to 70°, the greatest correction being + 2s. At greater distances the corrections needed are small.

Japanese earthquakes show a similar behaviour up to 50°, but beyond that distance they are not suited for determining corrections, since an error in the tables has the same effect on the residuals at the European stations as a displacement of the epicentre to the north-west, which cannot be checked on account of the distribution of the near stations. Oceanic earthquakes seem to show no need of corrections near 30°, but the small number and uncertainty of the observations make the probable error of the times large.

Byerly noticed the bend near 20° in the observations of the Montana earthquake, but it remained to be seen how general it was. Miss I. Lehmann has also, we understand from a letter, detected it in an Azores earthquake. Our data would agree with the existence of a discontinuous increase of velocity with depth, but Miss Lehmann's study of original seismograms seems to favour a continuous though rapid transition.

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Viscosity Measurements of Liquids by the Oscillating Disc Method

WITH reference to the advantage of this method described by A. van Itterbeck[1], it may be said[2] that another advantage it has over the capillary stream method lies in the insensitivity of the disc experiments to the presence of dust particles as compared with the sensitivity of the capillary method.

While, however, the disc method has its advantages in experiment, those who have used this method would probably agree that the accurate calculation of the absolute or relative viscosity of a liquid from the logarithmic decrement is not so satisfactory as the calculation from the capillary method.

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Nov. 11.

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[1] NATURE, 130, 399, Sept. 10, 1932.

[2] Fawsitt *Proc. Roy. Soc.*, A, 80, 290; 1908

Research Items

Symbolism of the Maze. In *Antiquity* for December Mr. W. F. J. Knight offers the suggestion that the design of the pattern stone of Bryn Celli Ddu is an inaccurately rendered maze formation. He points out that this motive, or the cognate motive of the spiral, occurs on one of the upright stones, and is also the actual structural design of the monument itself. It is assumed that the best kind of explanation of this triple occurrence is some form of magic—a maze embodying the ideas of defence and exclusion and of penetration of the defence. Maze ritual can be identified in the history of the maze form. The Troia, or 'Trojan game', appears to have been a ritual ride of armed horsemen practised in early Italy. Mazes are generally called 'Troys' in northern Europe. Virgil compares the movements of the Trojan game to the intricacies of the labyrinth at Knossos. A maze ritual was connected with the Eleusinian mysteries, the underlying idea being the initiation that leads to perfection, or the penance that leads to Paradise. The maze is also a symbol of secrecy, as in the story of Fair Rosamund. The sacred dance of the Salii at Rome, a protective processional, has been called a 'Troia on foot'. Both Saliian dance and Troia emphasise the distinction between within and without. Thus a maze becomes a protective wall of great magical strength with an entrance difficult for the unauthorised. It would appear that the name Troia is not a literary association, but is connected with a Latin verb denoting some kind of active movement. Troy, therefore, may have taken its name from the game and not vice versa. The connexion between the sites and beliefs of classical antiquity and bronze age Britain is probably to be sought in the rites of the British tumulus folk around their tumuli.

Yuman Music. Miss Densmore's studies of the music of the American Indians have covered Indians of woodlands, plains, high plateau and desert cultures. The songs she has collected among the Yuman and Yaqui of the River Colorado and north-west Mexico (Bull. 110, Bur. American Ethnol.), by contrast, belong to a river culture, based upon a rude, but efficient, agriculture, without irrigation and supplemented by hunting, and a life in settled villages. Among the Yuman the characteristic musical form consists of cycles of songs which are interpreted in legends. Some of the legends can be related in about nine hours, while others are longer. The story is told in the common language, but that of the songs is old and cannot be understood by anyone, the songs being learnt with the music by rote. The songs are episodic to the narrative. There is dancing in a few, but not all, of the cycles. In the deer dance and the corn dance only of those described do the dancers encircle the musicians. The characteristic form of the songs is periodic with one, two, or occasionally three, long periods and one short period containing the most pleasing part of the melody. There are rules for the repetition of the periods, but they are not strictly observed, especially by a good singer. Often they are sung for a larger number of times than is prescribed by the rule. The accompaniment shows great variety in rhythm. The songs are accompanied by rattle and by basket drum and also by nasal grunting and the pounding of feet. The grunting was used especially in hunting songs. There were two varieties of flute, and although there were no love songs, they were used by players standing in a group to attract the attention of the girls.

Measurement of Visual Acuity. In a report to the Medical Research Council (Special Rep. Ser., No. 173. London: H.M. Stationery Office. 1*s*. 6*d*. net) R. J. Lythgoe and Dorothy E. Corkill deal with the relation between visual acuity and illumination. Visual acuity, which in the wide sense includes the ability of the visual apparatus to appreciate contour differences, discrimination of two points, and legibility, is dependent upon physical, physiological and psychological factors. It is still widely held that visual acuity is at a maximum at an illumination of 3–4 foot-candles, and artificial illuminants giving more than 10 foot-candles are sometimes condemned. Values of more than a hundred times this figure are, however, frequently met with, and there is no doubt that acuity is considerably better under these high illuminations, though the rate of improvement is a constantly diminishing one with illuminations higher than 100 foot candles. High values of visual acuity are obtained only when the illumination falls on the periphery of the retina. The effect of glare was investigated; when the surrounds are dark, glare may increase visual acuity, but in an adequately illuminated room causes a fall. Another important aspect of the subject is dark adaptation; thus, the performance of a ship's outlook is defective if insufficient time elapses for dark adaptation or when there are bright lights in the field of vision. For accurate testing of visual acuity it is important to employ illuminations of more than 25 foot-candles, in a moderately light room. It is found that in commercial test-types the errors in the letter commonly exceed 10 per cent.

Forecasting the Herring Fishery off East Anglia. The readings of the annual rings upon the scales of herring and their correlation with the size of the fishes have given a clue to the sorting out of herring shoals in year groups. This in turn reveals the years which are prolific in young fish, and enables the fate of any year-group to be traced through succeeding years. Always provided that the sampling of the shoals provides a fair picture of the proportions of the year-groups and that the scientific analysis is accurate, these methods allow of an approximate forecast of the potentiality of the fishery for several years ahead. Dr. W. C. Hodgson summarises the results of his analysis of East Anglian herring shoals from 1923 until 1931, and shows how the data for 1923–30 were used to make a forecast of the 1931 season, the estimated result showing a close agreement with the actual catch (*J. Animal Ecology*, vol. 1, p. 108, 1932). Forecasting the herring stocks in the southern North Sea began in 1929, and, considering that the method is still in the experimental stage, have been reasonably accurate. But although the forecast can foretell the relative proportions of different year-groups, it cannot be taken as an accurate indication of the total amount of the catch, since this depends also upon extraneous factors, such as the suitability of the weather for fishing operations or the intensity with which the fishing is prosecuted, which in turn depends upon the potential demand for the catch.

Schistosomiasis in the Philippines. The occurrence of schistosomiasis japonica or katayama disease was recorded for the first time in the Philippines in 1906. The organism concerned is the Oriental blood fluke *Schistosoma japonicum*, but knowledge concerning its molluscan intermediate host in those islands has been greatly needed. In a recent paper (*Phil. J. Sci.*, 49, No. 2, 295–304; 1932) Mr. Marcos A. Tubangui discusses this subject and announces his discovery that the snail *Blanfordia quadrasi* has been found by him to be infected with cercariæ similar in every respect to those of *S. japonicum*. The snail occurs in moist places on the banks of small bodies of freshwater, and samples of the mollusc, collected near houses occupied by persons suffering from the disease mentioned, were found to be naturally infected. When the cercariæ were successfully introduced into mice and other laboratory animals the adult flukes, into which they developed, were similar to those of *Schistosoma japonicum*. The snail was further proved to be the missing intermediate host of the blood fluke by successfully infecting it with the miracidia stage of the parasite.

Root Nodules and Nitrogen Fixation. As No. 5 in the University of Wisconsin Studies in Science has appeared a sumptuous volume upon the "Root Nodule Bacteria and Leguminous Plants", by E. B. Fred, I. L. Baldwin and Elizabeth McCoy. This monograph reviews critically and adequately the enormous literature dealing with this subject and contains also a very judicial summary of the attempts made upon a commercial scale to supply the causal organism of the nodules to farmers. It is interesting to read the conclusion that nitrogen fixation in pure cultures of the nodule organism outside the plant remains still unsatisfactorily established, though the gain in nitrogen from the air by the activity of the living contents of the nodule is beyond doubt. The authors point out that different types of nodule, with different distribution on the root system, may have very different values. They conclude that the best results are obtained when the nodules are relatively few in number and large in size and borne on the tap root and the main laterals. A commonly accepted theory that comes out badly from this critical study is the view that the nodule is to be regarded as an abortive branch root. At the same time, the authors give little indication of the manner in which the vascular tissue develops within the nodule. They review briefly work upon root nodules on plants outside the Leguminoseæ and also upon the few cases where bacteria are reported as regularly associated as symbionts with leaves. In this review the root nodules of *Casuarina* receive very brief notice but Aldrich-Blake now publishes a note (Oxford Forestry Memoirs, No. 14, 1932) which would add *Casuarina equisetifolia* to the list of plants in which growth is materially improved when nodules are produced on the roots as the result of infection by a mixture of crushed nodules and soil.

Landslide at Toge, Japan. Two papers, by Prof. N. Nasu and Prof. N. Miyabe, have recently been published on this landslide (*Earthq. Res. Inst. Bull.*, 10, 674–693, 694–700; 1932). At the end of November 1931, it was found that at the village of Toge (about 12 miles south-east of Osaka), a land-block covering about eighty-one acres was slowly sliding downwards in a southerly direction. The block is bounded on all sides but the south-east by a zone of cracks, one on the west margin being a trench 550 yd. long and 88 yd. wide. The slope of the sliding area is about 15°. The landslide is of interest, not so much for its size, though it is one of the largest known in Japan, as for the various modes in which its displacement is being measured. Prof. Matsuyama carried out triangulations and precise levellings over the whole area. At the beginning of last February, Prof. Nasu installed recording instruments at points on the northern margin nearly 200 yd. apart. The motion of the mass was found to be very rapid. On February 20, the western station descended 6 in. and the eastern 13 in. The records, though on the whole nearly straight lines, show minute fluctuations, that Prof. Nasu measured with a recorder magnifying 2,000 times. On February 18 and 28, observations were also made with dial gauges at eleven stations on the northern boundary, showing maximum displacements of 0·39 in. on the first day and 0·28 in. on the second. The tilting of the mass was measured by a pair of horizontal component seismographs erected in Toge and, on February 18, was found to be 6′ to the south and nearly 4′ to the east. At the time of writing (June 20), the landslide was still going on.

Size of Fog Droplets. A paper entitled "On the Size of Fog Droplets" (*Sci. Papers Inst. Phys. Chem. Res.*, Tokyo, No. 391) by M. Kinoshita and K. Uchiyama, contains some information of meteorological interest relating to the size of the water droplets in artificially produced fog. Frequency curves are given for the distribution of different diameters of droplet in fogs produced in three different ways, namely, (1) by condensing low-pressure steam in a metal tube 15 cm. in diameter and 200 cm. in length surrounded by a water jacket for cooling, (2) by mixing air at a temperature of about $-50°$ C. with saturated air at room temperature, and (3) by using air of 70 per cent relative humidity instead of saturated air under the conditions of (2). It was found that type (1) gave a very scattered distribution, with many droplets between 2μ and 9μ in diameter. The other two types gave a pronounced peak of maximum frequency, at a little more than 3μ in type (2) and slightly more than 2μ in type (3). The authors point out that in experiments on the transmission of radiation through fog, experimenters would do well to study the best method of getting uniformity of size in the droplets. Their own experiments were made as a preliminary to the study of the transmission of infra-red rays through fog.

Internal Conversion of γ-rays. Two theoretical calculations of the probability of a γ-ray being photoelectrically absorbed in one of the electronic shells of the parent atom, have been published (*Proc. Roy. Soc.*, Dec.). In the first of these, by Hulme, the radiation field of the nucleus is taken as that of an oscillating dipole. The calculation differs from that of previous authors in that the accurate relativistic wave equation has been used for the planetary electron. The values obtained for some of the K-conversions of radium C agree well with the observations of Ellis and Aston. The paper by H. M. Taylor and Mott repeats Hulme's calculation for quadripole radiation from the nucleus. It is found that many of the conversions for radium B and radium C fall either on the 'dipole' or the 'quadripole' curves. This may be important for the theory of nuclear transitions, for it is shown that the dipole radiation corresponds to nuclear transitions in which the nuclear angular momentum changes by one quantum, while the radiation is in general of quadripole type for transitions in which $\Delta j = 0$ or ± 2. The paper shows that it is impossible to draw a distinction between the absorption of a γ-ray quantum and a direct interaction between the nucleus and the planetary electron. For certain nuclear transitions, it is probable that radiation is forbidden and the interaction takes place entirely within the nucleus. This may explain the 'anomalous' complete conversion of the radium C γ-ray at $1{\cdot}426 \times 10^6$ volts.

Crystal Structure of the Normal Paraffins. Dr. A. Müller has reported an investigation of the changes which take place in the crystal structure of the normal paraffins when the temperature is gradually changed (*Proc. Roy. Soc.*, Dec.). The specimens were contained in a thermostat maintaining any required temperature to one-tenth of a degree and they were examined by the reflection of copper radiation from a rotating anode tube, which allowed a reduction of the exposure time to about five minutes. Most of these substances crystallise at normal temperature with a long prismatic unit cell, but cells of lower symmetry are known for many of the hydrocarbons. When the substances are heated, the *a* and *b* axes expand much more than the chain axis of the cell. The relative lengths of these axes alter gradually in the case of the C_{21} and C_{23} hydrocarbons until the cell appears to become hexagonal. The members from C_{24} to C_{40} show a sudden transition to a new structure which tends to become hexagonal as the temperature is further raised. A rough picture of the molecular changes is given on the assumption that the molecule behaves as a rigid chain. The gradual transition observed in C_{21} and C_{23} is explained by the increase in rotational energy about the chain axis as the temperature is raised, with consequent approximation to higher symmetry. The sudden transition is pictured as a sudden rotation of the zig-zag molecules about their long axes on account of the equilibrium between the directive forces due to the long-chain part of the molecules and those due to the end groups.

Sodium Sulphite in Photographic Developing Solutions. Sodium sulphite is commonly considered to be merely a preservative for photographic developing solutions, preventing the oxidation of the developing agent by the air and also preventing yellow or brown stains on the negatives. It is now reported by Messrs. G. Gopala Rao and Madhusudanan Pandalai of the Andhra University (University College of Science and Technology, Waltair) in a communication addressed to the Editor, that the sulphite has also another function; it is said to regenerate the oxidised developing agent enabling the latter to reduce more than its equivalent amount of silver halide. It is also claimed that a mixture of quinone and sodium sulphite is capable of developing photographic plates.

Astronomical Topics

An Early Observation of the New Moon. The *Cape Times* of December 2 reports that the new moon of November 28 was seen with the naked eye in South Africa by Mr. A. W. Long and Capt. D. Cameron Swan 35 minutes after sunset, when its age was 17^h31^m. This is almost a record for South Africa; it was just beaten one Metonic cycle earlier on November 28, 1913; the age of the moon was then 16^h39^m. Observations of this kind have chronological importance, as many ancient nations began their months with the first observation of the lunar crescent, and it is important to determine the shortest interval after new moon that they would be likely to see it. The position of the moon's node is of importance in this connexion, and it will be noted that the Metonic cycle nearly reproduces this position, since the node completes its circuit of the ecliptic in 18 years 7 months.

Meteor Craters. Since the acceptance of the meteoric origin of 'Meteor Crater' in Arizona, many similar, but smaller, formations have been pointed out in different countries. Science Service for December 22 describes a paper by Prof. F. A. Melton and W. Schriever in which they ascribe a meteoric origin to a number of large holes in the Carolina States. They are elliptical in shape with their axes parallel; it is inferred that the masses producing them arrived from the north-west. Aeroplane photographs were used in tracing the outlines. The date of the impact is inferred to lie between the Pliocene and Pleistocene epochs, but cannot be fixed more closely.

Tables for Galactic Co-ordinates. Galactic co-ordinates are now of such frequent use in stellar problems that tables for conversion into them are welcome to astronomers. Prof. P. Emanuelli, of the Vatican Observatory, brought a volume out in 1929. Mr. John Ohlsson has just published more extensive tables in the Annals of Lund Observatory, No. 3; they go to every degree of Right Ascension and declination, and give the galactic co-ordinates and the parallactic angle to hundredths of a degree. For economy of printing the tables are limited to half the sphere; the results for the other half are obtainable by adding 180° to longitude and changing the sign of the latitude. The galactic pole is assumed to be in R.A. 12^h40^m, N.Decl.28° (1900). The zero of galactic longitude is taken as the intersection of the galactic plane with the equator of 1900. This is convenient for astronomers of the present day, but will cease to be so in the course of centuries; for this reason the International Astronomical Union, at the Leyden meeting in 1928, recommended reckoning from the star Alpha Cygni, which is very close to the galactic plane, and has a very small proper motion. However, it is easy to pass from one zero point to another; it merely requires the addition of a constant to the longitude. The constants required to reduce to several suggested zero points are given in the introduction.

In using the tables all Right Ascensions and declinations must be reduced to the equinox of 1900 before entering them. Since some workers may prefer to use another position of the galactic pole, formulæ of reduction are given to facilitate such a transformation. Since galactic co-ordinates to rough fractions of a degree are sufficiently exact for many purposes, a large diagram is published in the volume in which the circles for every ten degrees of each co-ordinate of equatorial and galactic systems are inserted, one set in continuous lines, the other in broken ones; resulting positions can be read off at sight. If a position comes near the edge of the diagram, it is more convenient to work with the antipodal position.

Recent Discoveries in Mexico and Guatemala

EXCAVATIONS on Monte Alban in the State of Oaxaca, Mexico, the site on which the rich grave treasure of gold and other ornaments was found in January of last year, were resumed at the end of October by Señor Alfonso Caso on an extended scale immediately the decision of the Supreme Court on the question of State jurisdiction over antiquities had been made known. By the end of November, according to progress reports for which we are indebted to Science Service (Washington, D.C.), some interesting results had been achieved, although in certain respects their exact bearing at present remains obscure.

Among the more striking of the finds is a tomb remarkable for its small size. It is less than 2 ft. wide, and not 7 ft. in length. It is lined with stone, and the door was closed with a corn-grinding stone. Immediately within the doorway was a headless skeleton; while at the back part of the tomb were a heap of human bones, four large dishes and animal bones. In addition, it contained two incense burners, two greenstone axes, jade, and a bird's skull. The most noteworthy feature of the discovery, however, is that on the front of the tomb, underneath the lintel and on the door jambs, as well as on the stone floor at the entrance, are paintings in red, green and yellow. If the culture is Zapotec, these are the first Zapotecan paintings to be recorded. It is concluded that they deal with the calendar, representing year- and day-names in the Mayan or Zapotecan calendar.

Outside the tomb were found a number of objects in pottery which have all the appearance of votive offerings—objects resembling ears of corn, human hands, a tiger's foot, etc., with the image of a corn god and another deity not identified.

Another find of a singular character is a series of human figures in eccentric postures. These were found as a border or frieze at the base of a stepped pyramid, or temple, which is now being excavated. This is known as the 'Temple of the Dancers' from figures on the walls of a stone-lined tunnel in the mound, which was penetrated a few years ago. Of the figures which have now been brought to light, some are shown as crawling or swimming, while others lie on their backs. One holds an object at his lips as if drinking. Others appear to be deformed. It is thought that the figures may represent a priestly orgiastic fertility rite such as was described by early Spanish writers. This view is supported by the emphasis laid on the sex of the figures—normally the priests were expected to be celibate.

A second tomb of almost identical dimensions, with a roof shaped as an inverted V, has been discovered. It contained parts of two skeletons with funerary furniture, possibly secondary interments.

It remains only to describe what is up to the present the most remarkable feature of the site, of which the purpose is at present obscure. This is a series of stone-lined tunnels too small to serve as emergency passages, as was at first suggested, and not apparently intended for drainage. The first was discovered at the close of last season's work, but its exploration left until this year. When it was entered on the resumption of work, it was found to be so small—20 in. high by 25 in. wide—that the explorers had to proceed stretched at full length on their backs and work their way along by elbows and toes. At a distance of 195 ft. in the tunnel a skeleton was found, accompanied by an incense burner, funerary urns and ornaments of jade, stone and turquoise as well as a few pearls. Some yards further the tunnel was found to be blocked and had to be entered again by a shaft sunk from the surface 25 ft. above for the purpose. A second skeleton was found 320 ft. from the entrance, just before the tunnel terminated at the side of the north terrace. It was found that a number of even smaller tunnels, not more than a foot high, led into the larger tunnel. Of these one had tiny steps leading down to it.

Two further tunnels of similar character to the first were found, but packed with earth or clay. Finally, a complex of miniature tunnels was found to the east of the famous treasure tomb. All are stone-lined and some are less than a foot high. Some, but not all, have the inverted V roof. The application of a smoke test revealed a number of unexpected exits.

The Carnegie Institution of Washington has now issued particulars of the important discovery of Mayan pottery made in 1931 at Uaxactun, Guatemala, by one of its expeditions (*News Service Bull.*, vol. 2, No. 36). This discovery was remarkable not only as an indication of the high standard attained in ceramics by the Maya at an early date, but also as the first example of a Maya date inscribed on any material other than stone or stucco.

The pottery was discovered in two burial vaults at the top of a pyramid in Group A in the so-called acropolis. This pyramid is the third in a series of five built one on top of the other in accordance with Maya practice.

Vault 1 is 7½ ft. long, 1¾ ft. wide and 2 ft. high, with walls of roughly-cut stone and six limestone slabs superimposed, as a cover. It contained the skeleton of an adult male with funerary furniture, offerings, ornaments, etc., among which was a remarkable polychrome vase. The second vault was approximately of the same size, though slightly shorter. It contained the remains of several skeletons and seven polychrome vases. Between the two vaults were two more polychrome bowls which had probably accompanied a secondary burial.

Of the polychrome vessels, which are painted in red, orange and black, all are sufficiently noteworthy; but three in particular stand out. A shallow bowl 14 in. in diameter, a flanged tripod dish and the cylindrical jar found in the first vault. All are painted with representations of one or more human figures. The most elaborate shows among other figures a naked man hanging head downward with two jaguars apparently about to spring on him. He is evidently the victim of a human sacrifice. The design is divided into two fields by the figure of a serpent across the vessel. The scene shown on the cylindrical jar is complicated; but it is thought to represent the reception of a deputation or embassy by a dignitary who is seated on a dais. The date, to which reference is made above, is shown in sixteen calendrical glyphs which have been interpreted by Dr. S. P. Morley, after a slight emendation, as giving the date 120 B.C. or A.D. 140 according to the chronological system employed in interpretation. This, however, is not the date of the vase; the painting is taken to be a record of an event long past.

Band Spectra of Diatomic Molecules*

DURING the last ten years, few branches of physical inquiry have called forth a greater output of published work than that of molecular spectra. Many reasons may doubtless be adduced to account for this. On the theoretical side, it is generally recognised that the anharmonic vibrating-rotating molecule with its complex magnetic couplings, and the interaction of these energy types with each other and with the electronic energy, provides one of the most fascinating applications of the quantum theory. On the experimental side, æsthetic considerations (and the interest of unravelling and ordering what is often a very complex system of spectral lines) must be given no little weight. Whatever may be the impressions given by a reading of the theory, the experimentalist is well aware that scarcely any band system is really typical or without peculiarities of particular significance for the structure of the emitting molecule.

Further reasons are found also in the variety of other fields of physical inquiry with which this subject has become closely related. The determination of the heats of dissociation of molecules from their spectral data is a well known possibility. The method is applicable to molecular ions and other diatomic molecules incapable of direct thermo-chemical investigation. In another field—that of isotopy—the discovery and quantitative estimation of comparatively rare isotopes of several common elements are well known. The prolific output of work on the spectrum of light scattered by molecules—the Raman effect—has among other things provided a new weapon for studying the solid and liquid states and the vibrations of complex molecular groupings. Molecular spectra have also made a definite contribution to astrophysical knowledge, while photochemical investigation stands clearly in a very close relationship to the subject. The nature of valency and of related topics, which has been clarified in recent years by the work of Heitler, London, and others, provides another link with chemistry.

For a subject with such wide associations, the collected literature has been remarkably scanty, even when we make due allowance for the difficulty of providing it during a period of rapid development. The present writer, faced with the problem of advising men wishing to undertake post-graduate research in this subject as to their reading, has found the answer one of perennial difficulty. The advice given has usually been: "Read certain sections of the National Research Council Bulletin on 'Molecular Spectra' and afterwards follow the original papers of some leading worker in this field, tracing the development of his thought in recent years". With the publication of the eminently readable report by the Physical Society referred to below, this difficulty should be resolved for many years.

Dr. W. Jevons is to be congratulated on the completion of a valuable piece of work. He has produced a model report, subsuming on the part of the general reader no previous specialised knowledge of the subject and yet providing for the expert a most useful compilation of data. Within the limits which Dr. Jevons has prescribed for himself, he has written a clear and well arranged account of the subject for which physicists and chemists alike will wish to thank him; research workers will do so more especially for the valuable appendices he has included. Through the tables and classified bibliography given here there is now provided a rapid and reliable approach to the literature of almost all known band spectra of diatomic molecules.

R. C. JOHNSON.

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* The Physical Society. "Report on Band-Spectra of Diatomic Molecules". By Dr. W. Jevons. Pp. vi + 308. (London: Physical Society, 1932.) 17*s*. 6*d*. net.

International Auxiliary Languages*

IN the pamphlets referred to below, Dr. Ritter gives us an excellent survey, with statistics, of the language situation of the world, and of the cogent reasons in favour of the adoption, by formal agreement, of some easily learned international language.

The complacent assurance, once almost universal, that the 'blessings' of industrial civilisation, and of 'English, well and clearly spoken', would rapidly extend to the whole of humanity, has given place to a sceptical attitude towards our own culture. A powerful reverse current has set in; many of our own eminent thinkers set the highest value upon a multitude of cultures, upon competition rather than fusion between them, even upon war itself. Innumerable students all over the world are being educated in languages, sometimes limited to one or two millions of people, which give them no access to English, French, and German literature. Those who are very good natural linguists may acquire all three of these, but the majority will acquire only one, and many, ungifted as linguists, will never read easily in any but their mother tongue. A point worthy of strong emphasis is the fact that inability to acquire foreign languages is in no way a sign of mental inferiority generally.

Dr. Ritter points out that the above facts limit the field of selection for persons who are to assist in international co-operation, as in the League of Nations. It is obvious that discussions carried on through interpreters are severely handicapped. The same argument applies, of course, over much wider fields. Dr. Ritter pleads for the formation by the League of a commission to study the problem, and hopes for the endowment out of private funds of an institute as well. He also puts forward his own suggestions for a world language; a phonetic, orthographic, and grammatical simplification of Mr. Ogden's "Basic English". It is much altered, but readily intelligible to an English reader, as soon as the rules of simplification are grasped. It is somehow less of a shock than the efforts of our own more advanced spelling reformers, or Prof. Zacharisson's "Anglic". Those whose hearts are set upon the retention of stylistic elegancies, even in the statement of pure matters of fact, will not like it any better than Mr. Ogden's "Basic".

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* "Die Sprache im internationalen Verkehr" (2nd ed., pp. 48) and "Die Weltverkehrssprache" (pp. 12), by Dr. Erwin Ritter, of the International Labour Bureau, Geneva. Printed as MS., 1932.

Dr. Ritter is concerned solely with the necessity for an officially recognised international language. He believes that no living language stands a chance of adoption owing to jealousy, and also to more realistic considerations of commercial competition. Further progress along the lines of Esperanto and Ido seems unlikely; all the signs point to Basic English competing with them successfully on account of its superior simplicity and practicality, wherever these qualities are called for. Also, the fact that to learn it is to make a good beginning with learning standard English tells enormously in its favour. Dr. Ritter's language (he has not named it) is somewhat easier to learn, since it has only 17 letters, three pronouns, and no irregularities; but learning it means learning English wrongly, and that will operate against it. But Dr. Ritter believes that only so, as an invented language, would it stand a chance of adoption by the League.

Edison's first invention was an electric vote recorder for Congress, designed to expedite business. It was gently but firmly explained to him that this is the last thing in the world that politicians desire.

H. S. H.

New Applications of the Cathode Ray Oscillograph

THE modern cathode ray oscillograph has now become a well-established tool of the physicist and electrical engineer for the experimental study of electromotive forces varying with time. In addition to its normal oscillographic use for the investigation of the wave-form of periodic electromotive forces, it has been extensively used for the study of transient or non-recurring phenomena, such as, for example, the reception of an atmospheric in a wireless aerial.

The electromotive force which operates the oscillograph may not, however, be the ultimate object of study; this force may be produced or derived in some manner from the phenomena which it is desired to investigate. It is well-known that certain reactions taking place in the human body, such as the beating of the heart, may be made to produce changes in the flow of current in an electrical circuit connected to the body in a suitable manner. The vibrating string galvanometer has been used extensively for this purpose in the past. It is quite probable, however, that the cathode ray oscillograph will find a useful application in this field shortly, since it has an advantage over the galvanometer in that it provides a continuously visible image of the derived electrical variations and the results of various experimental operations may be seen immediately on the oscillograph screen.

One of the difficulties accompanying the use of the cathode ray oscillograph in the past has been that of providing a suitable time-base for the spot of light forming the image on the fluorescent screen. In the June 1932 issue of the *Journal of the Institution of Electrical Engineers*, a description is given of a method of producing a circular time base as developed by the staff of the Radio Research Station, Slough. In this method, sine wave alternating voltages are applied in phase quadrature to the deflecting plates of the cathode ray oscillograph, with the result that a circular motion is imparted to the spot on the screen, the time of rotation of the spot being equal to the period of the alternating current supply. The electromotive force to be studied is introduced at a suitable point in the circuit and produces radial deflections of the spot from its circular path, without affecting the intensity or definition of the image. The time of recurrence or duration of the phenomenon under observation can be estimated from angular measurements on the screen, while the amplitude of the electromotive force is measured radially.

The paper referred to above mentions the possible application of the method to the comparison of high-order harmonic frequencies, and to the checking of the period of a seconds pendulum against an alternating current supply of accurately controlled frequency. In the latter case a rate of the pendulum corresponding to about 2½ seconds a day can be determined in a few seconds, while any departure from uniformity of the pendulum swing may be quickly studied.

Heavy Current Circuit-Breakers

IN most countries of the world the supply of towns and industrial districts with electrical energy is a matter of the greatest importance. The increasing size of central power stations and the extensive interconnexion of high tension networks, which in some cases spreads over the political frontiers of individual countries, makes the proper choice of protective apparatus essential to the safety of the system. One of the most troublesome faults arises when there is a short circuit in some part of the network. To counteract its effects apparatus to break the circuit, 'circuit-breakers', must be used in connexion with suitable relays. These must be capable of opening and closing on a short circuit several times consecutively without danger.

In the *Brown Boveri Review* for June last, H. Thommen describes the plant used in the Brown Boveri works in Baden for testing circuit-breakers. Prior to 1897, knife-switches with air-breaks were employed to break the circuit, but they were unsuitable as they produced very long arcs even at low pressures. C. E. L. Brown was the first to break the arc under oil and it was thought that this would give the perfect solution. It was found when breaking high power that oil circuit-breakers occasionally gave rise to serious disturbances. Sometimes the mechanical strength proved insufficient, or the opening distance of the contacts was too small so that flash overs to the casing resulted. Unsuitable contacts on heavy currents sometimes welded together and ruined the apparatus.

The very thorough tests carried out by the Brown Boveri Co. have cleared up many of the difficulties which lay in the way of designers. By means of slow-motion cinematography, they demonstrated the oil piston theory. According to this theory, rapidly growing bubbles form around the arc at rupture in the oil. The oil above the break is projected like a piston against the cover. When this happens a high pressure is rapidly developed and the current is broken. The total amount of gas produced depends on the energy dissipated in the arc and formulæ to determine this energy are given.

Recently there has been a revival of interest in water circuit-breakers. They have the advantage of not using an inflammable liquid but they do not eliminate the danger of explosion, since if the arc is not broken quickly enough, steam is produced in such quantities that the breaker blows up.

The compressed air breaker works satisfactorily as the pressure does not exceed a definite value, but a compressed air plant is necessary to operate it. Breakers without oil based on the principle of the action of a magnetic field on the arc have many advantages but on account of difficulties in insulation they cannot be used in practice with high voltages. Oscillograms are shown of how the current varies when different kinds of experimental breakers are in action.

Climate of Hong-Kong

"THE Climate of Hong-Kong", by T. F. Claxton, published by the Royal Observatory, Hong-Kong, as an appendix to the ordinary annual summary of Hong-Kong observations for 1931, is one of the most complete accounts of the climate of a station in the Far East. It summarises and discusses the observations made from 1884 to 1929. Most of the tables are in the form in which the mean value of a meteorological element, for example, atmospheric pressure, temperature, etc., for each hour is shown for each calendar month, the minimum hourly value of each element being taken as zero while the other values are expressed as departures therefrom in the customary units. A collection of tables of this kind makes a very indigestible meal for all except the expert meteorologist and for this reason the explanatory discussion is very welcome, particularly the general discussion of the seasons.

The seasonal rhythm in Hong-Kong is, of course, greatly influenced by the Asiatic monsoon. Lying practically on the Tropic of Cancer, the north-east monsoon in the winter does not give rise to much cold weather; a minimum temperature of 45° is reckoned a low one, while an afternoon maximum of 75°, for which in England one sometimes must wait until nearly the middle of the summer, is not rare in January. Mist and fog are of common occurrence in the period of rapidly rising temperature around March, generally when pressure is falling over China and the north-east monsoon is weakening; much of it is due to dynamical cooling of advancing damp southerly winds. The summer, with its mean temperature of 82° F., is characterised by unsteady winds, rather frequent thunder storms and heavy rain; the destructive effects of a typhoon are occasionally felt, more especially in late August. October brings back the north-east monsoon, and, generally, fine dry weather leading back through a quickly falling temperature to the winter.

There is a considerable section devoted to the discussion of typhoons, containing a number of important statistical tables, and the non-tabular part of the work ends with an interesting item seldom to be found in works of this kind—an account of the principal empirical rules of weather forecasting for the region under discussion.

University and Educational Intelligence

LONDON.—The Clothworkers' Company, the Grocers' Company, the Drapers' Company and the Skinners' Company has each decided to make very generous grants to the University in the shape of annual payments extending over a series of years. These grants will amount in all to £20,000 from the Clothworkers' Company, £10,000 from the Grocers' Company, £5,000 from the Drapers' Company, to whose munificent help for East London College the University is already greatly indebted, and £5,000 from the Skinners' Company. As in the case of the grants already announced from the Corporation of the City of London, from the Mercers' Company and from the Fishmongers' Company, these benefactions will be applied towards meeting the cost of the new Ceremonial Hall to be erected on the University's site in Bloomsbury.

A COURSE of ten lectures on alternating currents and electrical oscillations will be given by Dr. D. Owen, head of the Department of Physics and Mathematics of the Sir John Cass Technical Institute, at the Institute, Jewry Street, Aldgate, London, E.C.3, on Tuesday evenings commencing on January 31. The lectures will be accompanied by practical demonstrations. Further information can be obtained from Dr. Owen at the Institute.

THE school magazine coming from Stowe School, entitled the *Stoic*, is a sumptuously printed and illustrated record of extra-curricular activities among which film exhibitions have an important place. The school was one of the first to have a full-size silent projector and to change over to sound. Its recently founded Film Society aims at contributing towards the development of the art of the cinema by helping to prepare (in the words of the headmaster's inaugural speech) a forward-looking and active-minded public waiting to welcome the work of exploration through this medium of undiscovered territory of the mind. It is worthy of note that, in the list of films exhibited during last term, there are none of the professedly instructional type.

STATISTICS of secondary schools in the United States, published in a recent bulletin of the Office of Education, Washington, show an aggregate enrolment in 1930 of more than five million—roughly half of the population of secondary school age. The schools tend to increase in size, the average enrolment having increased from 211 in 1926 to 234 in 1930. Five per cent of them had, in the latter year, more than 1,000 pupils; 27 in New York and Chicago had more than 5,000, the largest of all having more than 10,000 pupils. Re-organisations, involving the incorporation in the secondary school scheme of some of the years previously covered by elementary school courses, have made considerable headway in recent years, especially in schools with from 300 to 2,500 pupils, two-thirds of which have now been re-organised. The proportion of men to women teachers in secondary schools, except in those for negroes, shows a tendency to increase. School libraries have increased in size steadily; the average number of volumes has risen from 1,652 in 1926 to 2,000 in 1930.

Calendar of Nature Topics

Tempora mutantur

1859, January 21.—The celebrated Eland dinner was held at the London Tavern, Prof. Owen in the chair. This dinner set on foot a movement for the acclimatisation of foreign animals, and the following year an Acclimatisation Society was formed with F. T. Buckland as organising secretary. By this time the Paris Société d'Acclimatation was in active operation. In 1857 it had offered a series of prizes "for the introduction into France, and her colonies, of various beasts, birds, fish, insects and plants". (Buckland's Life.)

1932—"Destructive Imported Animals Act," passed by the Parliament of Great Britain and Northern Ireland, placing restrictions upon the importation of foreign animals.

Skylark's First Song of the Year

Few naturalists' calendars fail to record the first singing of the skylark (*Alauda arvensis*) and most place it in the latter half of January or early days of February. At Selborne, Gilbert White heard it on January 21, and about the same period Markwick, at Catsfield in Sussex, places his earliest record on January 12 and his latest on February 27. Half a century later Leonard Blomefield (or Jenyns) gives his first record, at Swaffham Bulbeck in Cambridgeshire, as January 7, his latest as February 21, and the mean of his seventeen years' observations (1820–31, 1845–49) places the first singing on January 22. On the other hand, a twelve years' average in recent years, from data in the annual Phenological Report of the Royal Meteorological Society, fixes the date at February 11. Is the skylark really beginning its song season later in the new year than it used to begin ?

Duration of the Skylark's Song

There is a tendency to exaggerate the duration of the skylark's song ; a quarter of an hour is a common estimate, half an hour has been recorded, and an hour has been suggested as the maximum duration. But an accurate timing of more than a thousand songs, not reckoning those which failed to last half a minute, reveals a standard quite different. During three years, Noble Rollin timed morning songs in a particular locality (on the outskirts of South Shields) and found that the average duration of 549 songs was but 2·22 minutes. The yearly averages were remarkably consistent : 1927, 2·19 minutes ; 1928, 2·30 ; 1929, 2·20 (*Scot. Nat.*, 1931, pp. 47–54). Naturally, the song is not equally long throughout the year. It falls into two distinct periods, a spring period beginning in January or February, reaching a climax in May and June (average 2·7 minutes) and ending in the silence of August, and an autumn period beginning lustily in September (average slightly exceeding 3 minutes) and ceasing in November. A curious fall in the average length of the song which occurs in April, is suggested by Rollin to be possibly due to the late beginning of the younger birds, and their less practised singing ; but it is noteworthy that all the songs of 8 minutes and more fall within the spring or breeding period. The length of the song seems to be an individual characteristic, for the times of two special birds were found to be fairly consistent, all the recorded songs of one lasting, in minutes, 19, 17, 16, 29, 12, and of the other, 10½, 10¼, 19½, 1, 6. Moreover, it was noticed that the long singers kept together in one field, the short singers in another ; and since there is no suggestion of a selected chorus amongst skylarks, this curious fact seems to point to length of song being, in part at any rate, a function of age and practice, and to imply a certain amount of age segregation, the older and more practised larks separating into a colony distinct from the younger and less practised.

Arctic Ice passes Cape Farewell

January 25.—In the Arctic Ocean there is an almost continuous drift of ice from the sea north of Bering Strait towards the north of Greenland. During the winter, this floating ice-cap is firmly frozen, but in summer it breaks up, especially on the edges, and large masses of drift ice enter the ocean between Spitsbergen and Greenland, whence the East Greenland Current carries them southwards. The first ice-floes pass Angmagsalik in East Greenland about November 6, and reach Cape Farewell early in the following year, the average date being January 25. Rounding Cape Farewell, they travel northwards along the west coast of Greenland, reaching Godthaab early in May, after which the ice-masses decrease under the influence of summer melting. These remarkable movements of the arctic ice have important effects on the weather of the northern parts of the North Atlantic Ocean, as well as on the seal fisheries and the navigability of the northern seas.

Metamorphosis of *Calanus*

The small copepod crustacean *Calanus finmarchicus*, the numbers of which make it an important food supply of many marine organisms and so a link in the conversion of inorganic matter in the sea into human food, is now entering the last of its many stages. During January and sometimes even in the last days of December, it moults its final juvenile coat and becomes an adult, at any rate in the Firth of Clyde, for the change is not synchronous in different areas. This is the last of a series of twelve stages of development, six larval nauplius stages and five post-larval copepodid stages preceding the adult stage, and each stage leads to the next by way of a moult. The survivors of the hordes of the previous summer live through the autumn and winter, from September or October onwards, in the final copepodid stage, Stage 5 ; their development seems to be checked, only to be resumed with the January moult. During this month males predominate in the catches, but in February and thereafter females are more numerous, and this is true not only for the Firth of Clyde, but also in the English Channel, off the west coast of Ireland, and off the Norwegian coast.

What is the stimulus which breaks the autumn-winter condition and induces more rapid development and the final moult ? The scientific workers at Millport Marine Station have tested temperature. If the autumn stages are kept in the laboratory instead of the open sea, they moult in about three weeks. Low temperature definitely retards moulting ; but since the sea keeps getting colder until March, rising temperature can scarcely be the natural stimulus. Similarly light and food have been tested but neither seems to hasten the final moult ; there is no definite change in the sea that they know of which would provide the wanted stimulus.

Societies and Academies

Dublin

Royal Irish Academy, Dec. 12. J. J. Nolan and J. G. O'Keeffe: Multiply-charged large ions. Atmospheric condensation nuclei can be charged up so as to carry several thousand electronic charges. The mobilities appear to be unaltered. Spray ions have charges of the order of a hundred electrons. The existence of definite mobility groups for these ions is again demonstrated. R. W. Ditchburn: (1) *The frequency distribution of resonance radiation.* This paper discusses the frequency distribution of light emitted by an atom excited by the absorption of radiation the frequency of which is not exactly equal to the atomic resonance frequency. A recent experiment by Korff (*Phys. Rev.*, 41, 538; 1932) is criticised and it is suggested that this type of experiment cannot give any information on this question. (2) *The possibility of separating isotopes by the use of resonance radiation.* Photochemical reactions involving the use of resonance radiation are suggested.

Paris

Academy of Sciences, Nov. 28 (vol. 195, pp. 985–1048). Ch. Maurain and J. Devaux: Study on the total calorific radiation in Greenland. The solar radiation in the polar regions is relatively considerable. Comparisons are made with the corresponding figures obtained at the Parc Saint-Maur Observatory, near Paris. Emile Cotton: The non-rotational movement of a liquid limited by mobile, indeformable walls. Aymar de la Baume Pluvinel was elected a member of the Section of Astronomy in succession to the late G. Bigourdan. N. Botea: *Some partial differential equations.* C. Desaint: The transformation of the $(p+q)$th species for the domains of existence. Julius Wolff and Bastian Grootenboer. A property of a derivative of a function with a real positive part. D. Riabouchinsky: The hydraulic analogue of the movements of a compressible fluid.—L. Goldstein: The conservation of momentum in electron collisions.—Vaclav Bubenik: *The theory of electric filters.* W. Kemula and St. Mrazek: Measurements of the absorption of ultra-violet rays by methane, ethane and normal butane in the gaseous condition. Measurements were made of the absorption between the wave-lengths 6000 A. and 1965 A. Within this range, no radiation is absorbed by the three pure gases. A. Witt: *Starting oscillations of very high frequency.* P. Donzelot and J. Divoux: A method of compensating plate currents. Instead of the usual compensation making use of accumulators, to compensate the normal plate current of a valve, use is made of an identical valve, the same high-tension battery feeding both valves. Greater stability can be obtained. Th. V. Ionescu and C. Mihul: Ionised gases in the magnetic field: pressures greater than 0·001 mm. of mercury. The results of experiments on hydrogen and nitrogen are given graphically, showing the conductivity as a function of the wave-length, magnetic field, and pressure.—J. Janin: The spark spectrum of rubidium in the extreme ultra-violet. Papayanno: The influence of time on the conductivity of colloids measured at two different levels. E. Vellinger: The superficial affinity of caoutchouc for the loading. J. P. Mathieu: The compounds of tartaric acid and chromium. Chromium hydroxide dissolves in solutions of tartaric acid giving a normal tartrate *and this is transformed in solution into* a complex compound not giving the usual chromium reactions. This compound cannot be isolated in the crystalline state but its composition has been studied by physicochemical methods, acidity, conductivity, rotatory power and light absorption. These give it a formula of $H_2(TCr)$. Robert Berthon: The heats of moistening silica gel with various liquids. The experimental results are not in agreement with the hypothesis of Patrick and Grimm. Any purely thermodynamic theory of the heat of moistening of silica gel is incomplete because it neglects the geometric factors of the surface. Jean Galibourg: The influence of the value of the elongation realised in the course of successive extensions, followed by ageing, on the elastic limit and Young's modulus of a mild steel. André Kling and Alfred Soulier: The accidental ignition of vapours of petrols by electric sparks. The author considers that sparks produced by the friction of insulated bodies, such as pulleys in motion, are incapable of igniting mixtures of air and petrol. Pierre Jolibois and Louis Cloutier: The existence of basic phosphates. The existence of basic phosphates prepared in the wet way is doubtful. W. S. Reich: *Glycogen triacetate.* Under the conditions laid down, it is possible to acetylate glycogen, forming the triacetate and regenerate glycogen identical in all respects with the original glycogen. Jacques Bourcart: The marine Pliocene of Morocco. An attempt at the history of the Moroccan Atlantic. P. Geoffroy: Contributions to the geological study of the neighbourhood of Oran (Algeria). Paul Guérin: Hydrocyanic acid in *Glyceria aquatica.* With the exception of the fruit, all the organs of *Glyceria aquatica* give hydrocyanic acid, the young leaves and the flowers showing the highest proportion. Henri Coupin: The determinism of the formation of sporangia and zygospores in *Sporodinia grandis.* Pierre Gavaudan: Some observations concerning the physical structure of the cytoplasm of a hemi-ascomycete fungus, *Ascoidea rubescens.* Mlle. Dzung Tsing Wang: Cytological observations on *Ustilago hordei.* Charles Pérez: Differential characters of the sexes in hermit crabs of the genus *Diogenes.* André Bonot: The modification of the seric proteins isolated by the acetone method and myxoprotein. A criticism of the acetone method of Piettre and Vila. The author does not regard the fraction isolated and studied by Piettre, Achard and Arcand under the name of myxoprotein as a definite homogeneous fraction.

Melbourne

Royal Society of Victoria, Nov. 10. Elizabeth A. Ripper: The stromatoporoids of the Lilydale limestone. (1) *Actinostroma* and *Clathrodictyon.* The Silurian (Yoringian) limestone of Lilydale, Victoria, contains a rich stromatoporoid fauna. Four new species and one subspecies are described. *Actinostroma compactum* is closely related to *A. clathratum* Nich. of the British and German Devonian; *A. altum* to the Wenlock form *A. intertextum* Nich., while *A. verrucosum*, Goldfuss, is a typically Middle Devonian species. The species of *Clathrodictyon* are related to Silurian forms: *C. regulare cylindriferum* differs only from the European form *C. regulare*, Rosen, in the possession of astrorhizal cylinders; *C. calamosum* is of the type of *C. striatellum*, d'Orbigny, while *C. chapmani* is apparently distinct from all other species of

Clathrodictyon. **Jean Heyward**: Two species of *Ophiocytium Nageli* in Victoria, *O. terrestris* n.s. and *O. arbuscula* Rabenhorst. Two further species of *Ophiocytium Nageli* are recorded for Victoria. One, which was isolated from the soil, proved to be a new species and was named *Ophiocytium terrestris.* This is the first record of this genus from the soil. The second species, *Ophiocytium arbuscula* Rabenhorst, was found in a pool at Royal Park, Melbourne, attached to filaments of *Œdogonium* species. **Eileen E. Fisher**: The 'sooty moulds' of some Australian plants. Fungal forms have been isolated from 'sooty moulds' occurring naturally on the following hosts—*Bursaria spinosa, Leptospermum scoparium, L. lævigatum, Myoporum insulare, Melaleuca* sp. The composite character of the 'sooty moulds' is demonstrated. *Caphodium walteri* Sacc. on *Bursaria spinosa* has been shown by direct observation and cultural work to be *Teichospora salicina,* Mont., Gau. and demonstrates the cosmopolitan distribution of the type form of the genus. *Capnodium citricolum* McAlp, is synonymous with *Teichospora salicina. Teichospora australe* (Mont.) Arnaud is recorded on *Leptospermum scoparium,* as the common perfect form found on this host. *Teichospora australe* has been recorded previously on conifers in Australia, and the same fungus appears in the unpublished records of the Mycological Herbarium, Department of Agriculture, Victoria, under the name *Limacinia melaleucas* (nomen nudum) on 'tea-tree'. *Limacinia fuliginodes* is recorded on *Melaleuca* species and is the first record of this fungus for Australia.

ROME

Royal National Academy of the Lincei: Communications received during the vacation. **Q. Majorana**: Further results of a new photoelectric experiment. As regards the increased electrical resistance exhibited by certain thin metal foil under the influence of intense pulsating radiation, different metals show markedly varying behaviour. Silver displays characteristic sensitivity towards ultra-violet rays, but aluminium and possibly zinc also are insensitive to such rays. With other radiations the various metals examined exhibit the effect in greater or less degree.—**E. Fermi**: Oscillation and rotation bands of ammonia. **N. Parravano** and **O. D'Agostino**: Velocity of dissolution of industrial aluminas in fused cryolite. Three samples of alumina, prepared in different ways, were found to vary in the rate at which they dissolved in molten cryolite. **G. Rovereto**: A tectonic interpretation of the western promontory of the Gulf of Spezia. **M. Ghermanesco**: Orthogonal polynomials with two variables. Based on the property of orthogonality, a systematic theory of these polynomials is projected. The first results obtained are here detailed. **Hans Hamburger**: Ribaucour's transformation and spherical representation (2): applications of the transformation to spherical representation. **V. Hlavatý**: Further results on the differential projective invariants of a curve in the projective space P_{n-1} ($n =$ or > 3). **L. Labocchetta**: The effective integration of discontinuous functions (3): periodic functions. **Maria Pastori**: Conjugated hemisymmetric tensors. **E. Volterra**: 'Linked' elasticity and its mathematical representation. A new method of studying the deformations of elastic solids is developed which appears to be of practical value, as it allows various problems in elastic statics to be solved in a systematic and simple manner. **M. Cimino**: The Einsteinian correction of time in a planetary motion. Utilising the principle of equivalence of Levi-Civita previously applied, the author deduces a law of cosmic time and the anomalistic and sidereal periods of revolution for an Einsteinian motion in ordinary Euclidean space. **M. Kiveliovitch**: Regularisation of two body impacts for forces inversely proportional to any power of the distance. **E. Martin**: Method (2) for calculating the orbit of a visual binary. **A. Proviero**: Further considerations on the extinction of seismographs. **E. Guerrieri**: Periodicity in the progressive course of the rainfall at Capodimonte during 1833–1931. The data given reveal a distinct periodicity of fifteen years in the rainfall. The mean duration of the change from a maximum to the next minimum is 9·33 years and that of the succeeding rise to a maximum, 6·00 years. **M. Baccaredda**: The structure of sphero-cobaltite. **A. Baroni**: Diselenomesoxanilides and oxyselenanilides. When treated with selenium monochloride, malonanilide yields diselenomesoxanilide, M.P. 209°–210°, and malono-*p*-toluidine, diselenomesoxi-*p*-toluidine, M.P. 211°. Oxyselenanilide, B.P. 111° at 26 mm. pressure, and oxyseleno-*o*-toluidine, B.P. 130° at 26 mm., are obtained by the action of selenium oxychloride on aniline and *o*-toluidine respectively. When heated with aniline or diphenylamine in presence of zinc chloride, these two compounds yield greenish-blue dyes and thus behave similarly to the thionylamines. **G. Charrier** and **Elisa Ghigi**: (1) Action of alkylmagnesium iodides on (1: 9)–benzanthrono–(10). The action of magnesium methyl iodide on anthraquinone or anthrone or one of their homologues gives rise to the corresponding carbinols, but, under similar treatment, benzanthrone yields, not the methylcarbinol, but 4–methylbenzanthrone and 10–methylene–3:4–dihydrobenzanthrene; the latter readily loses two atoms of hydrogen, to form 10–methylenebenzanthrene. From magnesium ethyl iodide and benzanthrone, only 4–ethylbenzanthrone could be obtained. (2) Action of ammonia on acenaphthenequinone. This action yields acenaphthazine and naphthalimide, and other orthoquinones give analogous products. **G. Natta** and **R. Pirani**: Solid solutions by precipitation, and isomorphism between complexes of platinum and of quadrivalent tellurium (2): Examination of cæsium chlorotellurite and of the systems, $CsPtCl_6-CsTeCl_6$ and $Rb_2PtCl_6-Cs_2PtCl_6$. Strict isomorphism exists between cæsium chlorotellurite and the chloroplatinates of cæsium and rubidium. The precipitation method of preparing solid solutions appears to be of general applicability. **E. Parisi** and **G. De Vito**: Distribution of nitrates and 'organisation' of nitrogen in the leaves of green plants. While the laminæ of the sunflower are comparatively poor in nitrates, the petioles and veins are rich in these salts and often contain more than any other organ, even than the root. It is, therefore, probable that the nitric acid undergoes organisation on passing into the lamina. This conclusion is supported by the results of analysis of leaves of wheat and beet. Both the laminæ and the petioles contain more amino nitrogen in the afternoon than in the early hours of the morning, so that, in the green parts of the plant at least, sunlight exerts an appreciable influence on the formation of amino compounds. **V. Famiani**: The nutritive value of wheat embryos. Addition of wheat embryos to the diet of rats fed on wheat alone—which limited their growth and greatly lowered their powers of resistance—produces some improvement in growth and resistance, and the further addition of a saline mixture renders growth and reproduction almost normal. V. Zagami: Nutrition with leguminous seeds, and reproduction. A diet of leguminous seeds inhibits the reproductive functions owing, not to any specific effect on the genital apparatus, but to retardation of the general development of the organism. This effect is due mainly to deficiency of mineral salts and, to a less extent, to lack of the lipo-soluble factors A and D.

Forthcoming Events

Saturday, Jan. 21

British Mycological Society, at 11—(at the Botanical Department, University College, Gower Street, W.C.1). Symposium and Discussion on "The Measurement of Disease Intensity".

Monday, Jan. 23

University of Leeds, at 5.15.—Prof. A. H. Sturtevant: "The Determination of Sex in Animals".

Royal Society of Arts, at 8—(Howard Lectures).—Dr. Ezer Griffiths: "Thermal Insulation" (succeeding lectures on Jan. 30 and Feb. 6).

Royal Geographical Society, at 8.30.—Capt. G. N. Humphreys: "Climbs and Flights in the Ruwenzori Range".

Tuesday, Jan. 24

University College, London, at 5.30.—F. J. Richards: "An Introduction to Indian Archæology" (succeeding lectures on Jan. 31, Feb. 7 and 14).

Wednesday, Jan. 25

Royal Astronomical Society, at 5.30.—(Joint Meeting with the Geological Society).—Discussion on "The Development of Fractures in the Earth's Crust".

Institution of Chemical Engineers, at 5.30.—"Sewage Disposal". Papers to be read by H. C. Whitehead and F. R. O'Shaughnessy, L. R. Howson, and Dr. Karl Imhoff.

Institution of Mining Engineers, at 11—(at the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W.1).—Annual General Meeting.

University College, London, at 5.30.—H. J. Helweg: "Popular Education in Denmark: The Folk High School" (succeeding lectures on Feb. 1 and 8).

Thursday, Jan. 26

Bedford College, London, at 5.15.—"Contemporary Developments in Science." Lord Rutherford: "The Transmutation of Matter".

University of London, at 5.30—(at St. Thomas's Hospital Medical School).—Prof. E. Mellanby: "Iodine and the Thyroid Gland" (succeeding lecture on Jan. 27).

Mineralogical Society, at 5.30.—Dr. L. J. Spencer: "Meteoric Irons and Silica-Glass from the Meteorite Craters of Henbury (Central Australia and Wabar (Arabia)".

Friday, Jan. 27

Chemical Society, at 6.—(Ostwald Memorial Lecture in the Chemistry Lecture Theatre, University of Liverpool). Prof. F. G. Donnan.

Royal Institution, at 9.—Sir Charles Peers: "The Ancient Monuments of England".

Saturday, Jan. 28

British Mycological Society, at 11—(at the Botanical Department, University College, Gower Street, W.C.1).—Symposium and Discussion on "The Measurement of Disease Intensity".

Official Publications Received

GREAT BRITAIN AND IRELAND

The Journal of the Institute of Metals. Vol. 49. Edited by G. Shaw Scott. Pp. 416. (London: Institute of Metals.) 31*s.* 6*d.*

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1479 (T.3237): Wheels, Fairings and Mudguards. By F. B. Bradfield and G. F. Midwood. Pp. 14+13 plates. 1*s.* net. No. 1485 (I.C.E.838, 838a and 839): Radial Engine tested at Reduced Mixture Strength and with Variable Ignition Timing. By J. Swan and A. W. Morley. Pp. 12+15 plates. 9*d.* net. No. 1489 (T.3279): Lift and Drag measured in a Velocity Gradient. By F. B. Bradfield and J. Cohen. Pp. 4+4 plates. 4*d.* net. (London: H.M. Stationery Office.)

London School of Hygiene and Tropical Medicine (University of London). Report by the Dean on the Work of the School for the Year ended July 31st, 1932. Pp. 50. Eighth Annual Report to the Court of Governors, 1931–32. Pp. 14. Post-Graduate Instruction in Preventive Medicine. Pp. 32. (London.)

Proceedings of the Royal Society. Series A, Vol. 139, No. A837, January 2. Pp. 236. (London: Harrison and Sons, Ltd.) 12*s.*

Rubber. By W. A. Williams. (Streatfeild Memorial Lecture, 1932.) Pp. 23. (London: Institute of Chemistry.)

OTHER COUNTRIES

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The Census of India, 1931[*]

THE Government of India showed both a commendable wisdom and a grasp of the realities of the situation in publishing an abstract of the main statistics of the census of 1931 while the Third Round Table Conference was still in session in London. The figures which are included in the abstract are of the greatest significance. Indeed, they are vital for an appreciation of the essence of the matters under discussion. By sheer weight of numbers, they bring out the magnitude of the problems involved in the proposed constitutional changes; and by indicating tendencies in the movements of population, they afford guidance in judging the possibility of permanence in an arrangement which aims at the form of democracy, but will depend for its working upon a delicate adjustment of the relations between different sections of the people.

The magnitude of the figures alone is stupendous. The destiny of more than three hundred and fifty millions of people is in the balance. The total population of India, as actually given, is 352,837,778, of whom 271,526,933, inhabitants of British India, are to receive the benefits and privileges of democratic institutions—the vast majority of them, however, for the present, in an attenuated form—and the remaining 81,310,845, natives of the Indian States, will be brought within the constitution of India under the scheme for federation.

The area of the Indian Empire, according to the latest estimate, is given as 1,808,679 square miles. This gives on the census figures of total population a mean density of 195 per square mile, the maximum being found in Cochin State, with a population of 814 to the square mile. In British India the most thickly populated area is Bengal, where there is a population of 646 to the square mile. The most sparsely populated areas in the Empire are Baluchistan with 5, and British Baluchistan with 9 to the square mile.

The statistics of total population, impressive as they are, must be taken in relation to the fact that they represent an increase in the ten years which have elapsed since the last census of 10·6 per cent. This rate of increase contrasts with an increase of 1·2 per cent in the previous decade, and has not been equalled since the period 1881–91; but there is no reason to suppose that with continuing improvements in sanitation and hygiene and the reduction, if not the elimination, of the incidence of famine and plague, a rate of increase substantially little lower will not be maintained, unless some unforeseen cause should introduce any serious modification in the conditions of life among the general run of the population.

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[*] Census of India, 1931. Abstract of Tables giving the Main Statistics of the Census of the Indian Empire of 1931, with a Brief Introductory Note. Pp. 16+2 maps. (Calcutta: Government of India Central Publications Branch, 1932.) 9*d*.

Notwithstanding fluctuations in the decennial rate of increase, the growth of population since 1881 represents an increase of 39 per cent. A part of this, however, is due to the extension, from time to time, of the area brought under the operation of the census.

Enfranchisement, however gradually extended to a population of this size, would be an undertaking of sufficient magnitude in itself, especially among a population which speaks some 225 languages, exclusive of dialects, and ranges culturally from the level of a jungle tribe to those whose standard of civilisation may differ in kind, but does not differ materially in degree, from that of a member of an equivalent class in European society. In India, however, as must by now be generally appreciated, the initial difficulty is complicated by sharply marked divisions of race and creed which have given rise to the 'communal' problem. An electoral system, based on a territorial allocation of representatives, has to be adapted to represent justly different races and different creeds, each of which has its own social organisation and habits and, inevitably, its own distinctive and peculiar bias in political outlook arising therefrom. Even in the fairly homogeneous communities of the West, the problem of minorities has never been solved satisfactorily, although many attempts have been made. It has been said that the only right of a minority is that of turning itself into a majority. In India, if only the warmth of discussion and the wealth of argument were taken into account, it might not unreasonably be concluded that minorities alone had a claim to consideration.

This sensitiveness to the claim of minorities, abnormal as it would at one time have appeared to the average citizen of a European State, arises, it is seen, from a very real and irreconcilable incompatibility in thought, habit and religion between the different sections of Indian society, which, particularly as between Hindu and Moslem, at times flames out into acts of open hostility. The facts which the constitution will have to face are revealed in the tables of enumeration according to religions.

Taking the principal religions only, but omitting Buddhism which, practically, is confined to Burma, in all India there are :—Hindus, 239,195,140; Moslems, 77,677,545; Sikhs, 4,335,771; Tribal, 8,280,347; Christians, 6,292,763. In British India, the predominant factor is the relation between Hindus and Moslems; and within the ranks of the Hindus, the relation of the castes to the Exterior Castes, or, as they are more popularly known, the Depressed Classes. Here the figures are Hindus 177,727,988, of whom 40,254,576 are numbered among the Depressed Classes. The Moslems number 67,020,443; Christians, 3,866,660; Sikhs, 3,220,997; and Tribal, 5,779,709. More important than the totals, however, is their distribution and interrelation in the various provinces, upon which the question of representation has to be decided. In the fifteen provinces (including Burma and the Andamans) under which the figures are given, the Hindus are in the majority in ten, while the Moslems predominate in Bengal, the Punjab, Burma (not counting Buddhists), Baluchistan and the North-West Frontier Province. The Sikhs number 3,064,144 in the Punjab, exceed forty thousand in the North-West Frontier Province and the United Provinces of Agra and Oudh and are present in eleven other provinces in varying degree, the numbers, however, being relatively small.

Incidentally, it may be of interest to note the definition of Exterior Castes adopted for census purposes, which differs in certain respects from that of the Franchise Committee of the Round Table Conference. It includes all castes which are excluded from access to schools, wells, public bathing places, temples and in some cases burning ghats, which are refused for service as barbers, tailors or washermen, from whom water is not accepted, and who convey pollution by contact or proximity. The Depressed Classes had expectation of abolishing, by a declaration of equal rights to be incorporated in the constitution, the regulation or custom of exclusion from schools and other like places open to the higher castes, and other distinctions of inferiority.

The figures relating to the religious communities gain in significance when viewed proportionately, especially in their bearing on the political problem. In the decennial period, the increase in the Hindu population has been 10·4 per cent; but among the Moslems it has been 13 per cent; or, expressed in ratios per 1,000, the Hindus have fallen from 684 to 682, while the Moslems have risen from 217 to 222. This latter figure is the continuation of a steady increase which has been going on for the last half-century. The tribal figures also show a decrease in the decade—from 31 per thousand to 24, but this does not necessarily mean that the tribesmen are decreasing in numbers. It is probably to be accounted for in greater part as due to transference to the number of Hindus, in accordance with the process of Hinduising the tribal religions which has been in progress from time immemorial.

Among the remaining figures which may be regarded as having special significance in relation to the transitional phase through which India is now passing, are those giving the degree of literacy, the proportion of urban to rural population, and occupations.

The figures for literacy show a marked advance. The number per 1,000 aged five years and more who can read and write is 156 male and 29 female. In 1921 the corresponding figures were 122 male and 18 female. The number of literate females is now more than four millions, whereas thirty years ago they numbered less than a million. Among the Depressed Classes in British India, the percentage of literacy is 1·6.

The real India, it is always said, is the India of the rural population and the agricultural classes, although the urban population may be more in evidence and may thereby, in changed conditions, obtain more and more a preponderating voice in the affairs of the people. The urban population is undoubtedly growing and may be expected to increase more rapidly as India becomes industrialised and draws a proportion of the rural population to the towns, as it has already begun to do, for example, in Bombay. Since 1921 the increase in the urban population has been 0·9 per cent and it now numbers 11 per cent of the total. In occupations, agriculture accounts for 66·4 per cent of the working population. There is some doubt as to the exact numbers engaged in organised industry; but they are put at about 3,250,000 and at a maximum not exceeding 5,000,000, while the number employed in establishments governed by the Factory Acts is 1,553,169.

These, then, are the more significant of the figures which give the statistical side of the problems confronting those who have to frame a constitution for India. Their object is to adapt an essentially western institution to an eastern community, in which caste, the antithesis of democracy, prevails as the determining factor in the lives of the vast majority of the community and influences even the Moslem. It may, indeed, be regretted that the opportunity was not sought to develop native Indian institutions; but such regrets are unavailing. It is probable that the die was cast irrevocably in the days when Indian culture was despised and a university system was set up which was devised to throw open to India the way to development along western lines. Time and stress alone can prove the wisdom of the course that has been chosen.

The Spirit of Research

The Spirit of Research. By Dr. T. Brailsford Robertson. Edited by Jane W. Robertson. Pp. xiv + 210 + 2 plates. (Adelaide: F. W. Preece and Sons, 1931.) 8*s*. 6*d*. net.

BRAILSFORD ROBERTSON devoted a brief but intensive life to scientific research, during which he found time to write essays of a more general appeal, some of which are collected here in book form. Born in Edinburgh, he went at an early age to Adelaide, and after a period of thirteen years in California, returned there as professor of physiology in 1919, where he died in 1930. This book, which in a sense is a memorial volume, is an all-Australian production: we like to regard it as a symbol that the torch of scientific truth burns brightly under the Southern Cross.

Robertson was an enthusiast: he was fortunate to come early after graduation under the influence of another enthusiast, Jacques Loeb, with whom he worked, and later succeeded, at Berkeley, California. Both were sceptics of accepted doctrines, both were men of fearless independence and unbounded energy. It was Loeb's influence that caused Robertson to attack big problems rather than work in restricted fields, and encouraged him to undertake the problem of growth and senescence as his main life work.

It is the spirit of research that counts. Observations, comparison, deduction, trial are the factors which have established all we know from the days of such a primitive act as the production of fire to the latest hypothesis of the structure of the atom. Loeb used a simple shed on the sea shore with an equipment of the simplest and cheapest character for his experiments on the artificial parthenogenesis of sea-urchins, and yet obtained results which are among the most valuable in biology. The modern physicist requires the most complex and costly apparatus for his experiments on the smashing of the atom.

Since the War, research has been discovered to have a cash value and it has become popular alike with the Press, public and those persons who practise it as a means of livelihood. There are not wanting those critics who would avoid the use of the term 'research' for such work and prefer to call it investigation. At any rate, no one will deny that a cash reward is not in harmony with the true spirit of research. Precisely in the proportion that the worker devotes himself to research, so he must relinquish the desire for success of the kind expressible in cash. The consciousness of service must suffice as the sole reward. Discoveries creep gradually into public consciousness; suddenly they may become the latest marvel of science, only to develop in a very brief period into a commonplace of existence.

The rate of progress made by science in providing the amenities of life during so short a period as the last decade is amazing, but there is still something to be done to accelerate the coming of a future such as pictured by H. G. Wells, in which we have a control over many things which to-day seem to us almost sacred. The public readily appreciates a showy building; it must be brought to realise that it is experimental research which at all times needs endowment. Most of all, however, we must beware that the budding genius is left unfettered and not destroyed at the beginning of his career, by the system of examinations at school and college. Such mediocrity is exhibited by the papers published in our scientific transactions and proceedings that one can but have serious anxiety in this respect. It is made far too difficult for the unorthodox and eccentric young man to gain his chance of promotion: the investigator in fields of inquiry which are not the fashion of the moment often finds it hard to gain recognition and support.

The ultimate aim of all scientific research is to better the position of man; chemistry in particular, now that the knowledge of the structure and behaviour of the individual substances has been mastered, is in a position to help in the greater biological field. There must be a chemical basis to growth, to senescence, to heredity, even to personality, and all else that happens in the body. Robertson began in Australia the study of such questions as the value of phosphates on wool production, and of a cystine-high diet on the quality and quantity of this staple production of the country, experimenting with so many as 80,000 sheep. He makes a plea in one of his essays for the fostering of research on a large scale in the wide open spaces of the earth, instead of concentrating it in laboratories among the crowded centres of population.

It is an axiom that a well-balanced mind is essential for a research worker of the highest class, however much he may be a specialist in his laboratory. To be appreciative of art, of literature and of music, with a love for his country, his home and his work are desirable attributes. Such a man was Brailsford Robertson, and the keen spirit of enjoyment which permeates his essays makes them worthy of more than passing perusal.

E. F. A.

Hydrodynamics

Bulletin of the National Research Council, No. 84: Report of the Committee on Hydrodynamics, Division of Physical Sciences, National Research Council. Pp. ii + 634. (Washington, D.C.: National Academy of Sciences, 1931.) 4·50 dollars.

IN each of the processes involved in the study of fluid motion—in observation, measurement, physical explanation, and calculation—this century has seen notable advances. There are improved methods of making the flow visible, and a technique for measurement in thin layers of fluid next to solid boundaries. Enlightenment and understanding have followed recognition of the importance of the motion in such layers, which to some extent has proved amenable to calculation. Such calculations are important mathematical advances; but to most mathematicians the greatest achievements are probably those resulting from skilful use of ideal fluid theory, with circulation and vorticity included. There has been progress in turbulence theory, and in research on compressible fluid flow; and though, on the whole, most attention has been paid to motion past obstacles and in pipes, with their technical applications, it must be remembered that the study of waves and tides has not been without incident in recent years.

There is, then, a wide field on which to report. In any one-volume report selection will be necessary, and we turn to the volume before us to determine first how the selection has been made. Without preface or foreword, after a scanty contents table, the book opens with a short chapter by Dr. H. L. Dryden, which, called a general survey of experimental hydrodynamics, actually summarises experiments on flow past obstacles. Aerofoils occupy a small space; airscrews are not mentioned. In the next chapter Prof. F. D. Murnaghan gives an elementary presentation of monoplane aerofoil theory, and the parts of ideal fluid theory necessary for it, together with an inadequate account of calculations of flow past a body of revolution.

The rest of the book is by Prof. H. Bateman. In the third chapter, which closes the first part of the report, he writes on the general physical properties of a viscous fluid. There are three more parts—on the laminar motion of a viscous fluid, on turbulent motion, and on compressible fluids—each fairly full. The number of references given is enormous. Each of the first two chapters, and each small section of Prof. Bateman's, is followed by a bibliography, and there are additional references at the end of the book. Many matters not dealt with in the text are mentioned in these bibliographies, which seem, indeed, extraordinarily comprehensive.

The committee has thus succeeded in giving full reports on viscosity, turbulence, and compressible fluids by sacrificing large portions of ideal fluid theory. The omission of waves and tides reflects the influence of aeronautics on hydrodynamical research; and while reports on Levi-Civita's extension of the mathematics of free stream-line motion, the use of integral equations, and approximate numerical solutions would have been welcome, most striking is the omission of a discussion of the Kármán vortex street and the resulting drag formula, all the more so since the presentation of aerofoil theory is similar, in some places, to Glauert's, and space could have been saved by a reference to his book. It is a pity, too, that room could not be found for descriptions of experimental technique.

Dr. Dryden's chapter is one of the best, but too short. Experimental results are summarised as well as possible in the space, and modern theories receive due mention. There are, however, no pictures, diagrams or tables. To print a chapter on experimental hydrodynamics without any of these aids to the understanding is an unwelcome innovation for which no price reduction can make amends.

Prof. Murnaghan's account is connected; his mathematics is clear, and well decorated with illustrations; but the account is restricted to rather elementary matters, and airscrew theory is completely omitted. The insistence on the *ad hoc* nature of hypotheses in Prandtl's aerofoil theory is unfortunate; the theory is a first order theory capable of development in a rational manner. Prof. Murnaghan's one innovation in the theory is to suggest that the downwash should be compounded with the velocity at the trailing edge, rather than with the undisturbed velocity, in the usual calculation of induced drag. But the velocity at the trailing edge is zero if the angle there is finite. The confusion probably results from a lack of understanding of the approximations.

Prof. Bateman presents us with an embarrassing wealth of information, drawn from many sources, at times presented somewhat uncritically, and not easy to read. The report often has the character of a number of results loosely strung together. The treatment of laminar viscous flow is largely mathematical; formulæ abound; tables and diagrams are absent; so that, of quantitative results, only those expressible by formulæ are presented. Thus the drag on a plate according to boundary layer theory is given, but not the velocity distribution. Neither here nor in the first chapter is there comparison with experiment. How we miss those diagrams!

The reporting appears to be generally accurate, but when so wide a field is covered, errors are inevitable, and some five or six have been noted. Too much space seems to have been given to mathematics with minute physical significance. Occasionally important results remain buried in the bibliographies; and sometimes, also, certain matters find their only mention in odd company. There is an unwillingness to include any detail about general physical ideas; several examples might be given, of which one of the most important is the complete lack, anywhere in the book, of an adequate discussion of the production of circulation and vorticity in fluids of small viscosity.

It is not easy to find the place. The index is far from complete, and the page headings do not help—always "Hydrodynamics" on the left and the title of the part on the right. Prof. Bateman's frequent omission to give references to papers previously mentioned wastes time. But these are minor blemishes on a valuable work of reference to the making of which has gone great learning and knowledge. There is, indeed, a vast store of information here, much of it not to be found in any other book in English. S. G.

Oceanographical Work of the *Carnegie*

The Last Cruise of the Carnegie. By J. Harland Paul. Pp. xvii + 331. (Baltimore: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1932.) 26*s*. 6*d*. net.

THREE years ago the *Carnegie* met her fate when at anchor in Samoa owing to an explosion when loading gasoline for her auxiliary engine. The loss of a fine vessel, built expressly for the study of terrestrial magnetism, was a catastrophe, but this was completely overshadowed by the death of Capt. Ault, fine seaman, skipper and navigator, enthusiastic and generous scientific chief. The *Carnegie* was the most widely known of all vessels, for she had already made six cruises mostly across unknown areas of sea and visited many strange ports. Capt. Ault was in command of three of these, and this story of her seventh cruise is eloquent as to his practical qualities and to his high efficiency as leader. Ventures and dangers are passed by so lightly, as in recent War dispatches, that at times the reader wonders whether the author appreciated them and understood fully the quality of his 'skipper'.

The *Carnegie* was a brig, 128 ft. on the loadline, 155 ft. over all and 33 ft. beam, drawing 14 ft. and setting about 13,000 sq. ft. of canvas, with auxiliary engine of small power. She was built on fine yacht lines and usually set a large leg-of-mutton mainsail. Her peculiarity lay in her build, no iron being used in any part and even avoided in loose tools and gear. This, while highly advantageous to her studies of terrestrial magnetism, had obvious disadvantages, manila rope not forming a good anchor warp, as off Easter Island where it was cut through on the rocks. Phosphor-bronze was a poor substitute for steel in the wire on the winches. This was necessary, for the seventh differed from the earlier cruises in that oceanographic stations were to be established, depths, temperatures, salinities and other chemical factors to be observed, while plankton was to be collected from various depths. Echo sounding gear was also fitted, to be checked by bottom sounding. Clearly no expense was spared in attempting to obtain perfection in equipment, but nevertheless unforeseen accidents were numerous, the sonic gear being out of commission at one period. At the same time, great attention was to be paid to atmospheric electricity and to air movements aloft, so far as could be observed by balloons, to prepare the future "Sailing Directions" for aeroplanes. Further, perhaps an embarrassing feature, the ship was seldom out of touch by radio with her headquarters at Washington, although sailing in the most distant waters of the Atlantic and Pacific Oceans.

The cruise started on May 1, 1928, and Plymouth and Hamburg were visited for intercomparison of instruments and methods and for additional gear. The course was then set to Iceland, often a bad landfall on account of local compass deviations which demand constantly checked variation charts. Dr. Paul is enthusiastic of this land of "the mother of parliaments" with its culture, "the highest general level of our whole cruise". Regular oceanographic stations were taken across the Sargasso Sea and thence westwards to Barbadoes and Panama, where the *Carnegie* went into dry dock. It was a hard fight to clear the Galapagos and so out into the Pacific, the run to Easter Island taking 42 days. Then follows an excellently illustrated description of this ever-interesting land, famous for its carved figures, centre of a weird civilisation, an everlasting and probably insoluble problem. The suggestion put forward here is that of a relic island of a once large archipelago, but we have failed to find any scientific evidence for any great lands in the mighty Pacific's waste of water.

To reach Callao a great loop to the south-east had to be made to catch the 'westerlies', the least known of ocean areas being traversed. Sectional charts of water temperatures and salinities give food for thought, and an offshore ridge was charted rising 10,000 ft. to within 650 fathoms of the surface. The *Carnegie* then picked up the 'trades' to Tahiti and Samoa, keeping well to her line of latitude and carrying out her routine of magnetic, electrical and oceanographical observations highly successfully. The Tuamotu Group was crossed, but we searched in vain for any hint as to the shape of the underlying foundations of this great coral group. Good samples of the bottom deposits were secured and should prove interesting. A sailing vessel, however, was clearly not suitable for much of the oceanographic work, for to secure the best samples it is advisable to keep the ship's head to sea with the engines going slowly so that she makes no way. The warps for bottom samplers and for water and plankton nets ran out at sharp angles, as much as 75° from the vertical, and closing or reversing messengers were often hung up by animals unintentionally caught up on the wires. The latter sometimes fouled, for apparently the staff tried to carry on all their observations synchronously, and the loss of water bottles and thermometers was so considerable that the captain must have heaved a sigh of relief when he again got his ship on her course.

From Samoa to Guam, a prosperous United States colony, was clear sailing, and *en route* to Japan was obtained the deepest sounding of the cruise, 8,350 metres. Tokyo was reached after typhoon experiences which must have tried the *Carnegie*. The voyage thence to San Francisco, 36 days, on a very northerly course, heavy seas, overcast skies and perpetual foghorn cannot have been a happy experience, but there were doubtless consolations in a well-earned rest in the home port.

The further plan of the cruise included a visit to Australia and a complete circumnavigation of the world before the 'westerlies' of the Southern Ocean. Hawaii came first and then the tragic end in Apia Harbour, famous in our naval annals for the feat of the *Calliope* in putting to sea in a hurricane, when six war vessels piled up on that harbour's shores.

The scientific results of the *Carnegie* had all been dispatched home before her end, and Dr. Paul's narrative is a desirable supplement telling us how they were obtained. It is a pleasing and instructive story for all who "go down to the sea in ships"—but why is the vessel pictured on the binding as an idealised three-master that never could have sailed on any sea ? J. S. G.

Short Reviews

The Law of Patents for Chemists. By Dr. J. Rossman. Pp. ix+304. (Washington, D.C.: The Inventors Publishing Co., 1932.) 3.50 dollars.

DR. ROSSMAN has packed into this volume much information that is of interest to chemists in Great Britain as well as in the United States, and the sections on essential patent law principles and on the procedure for obtaining the patent are of general interest although primarily relating to American patent law. From this point of view the book should be of real value to chemists in providing a comprehensive survey of the technicalities of patent law in a manner which is intelligible to chemists without legal training. A glossary and a bibliography of books and periodicals add to its general utility.

From a broader point of view the book is disappointing. At a time when the evil of paper patents is generally acknowledged and is so serious and widespread that the suitability of the patent system to modern industry, and especially chemical industry, has been openly questioned, it is surprising to find that the chapter on "What is Invention ?" indicates little appreciation of the fundamental problems which now arise in the relations between scientific and industrial research and invention. These difficulties have been ably delineated by Mr. C. C. Paterson in an appendix to the Report of the British Science Guild on the "Reform of the British Patent System". Similar difficulties exist in the United States and some indication of the attitude of patent law opinion in that country, particularly on the suitability under modern conditions of 'inventive ingenuity' as subject matter for a chemical patent would have been welcome, as well as reference to the related question of protecting scientific discoveries or scientific property. These should not have been omitted in a book addressed to scientific workers, and the brief discussion on patent rights, particularly those of employer and employee, would have gained value from a broader vision and from reference to the studies on the position of the salaried inventor carried out for the International Labour Office and the League of Nations in recent years.

Forensic Chemistry and Scientific Criminal Investigation. By A. Lucas. Second edition. Pp. 324. (London: Edward Arnold and Co., 1931.) 18*s*. net.

THE second edition of this excellent textbook appears at a time when a reminder of the immense services which the man of science can render in the prevention and detection of crime is more than opportune. Recent discussions on the increase of crime in Great Britain during the last two or three decades have suggested doubts as to whether the authorities are making sufficiently full use of the resources of science in protecting society against those who are prepared to prostitute the discoveries of science for criminal purposes. The new and enlarged edition of this book includes references to many of the important advances which have been made during the ten years since the first edition was published, in the use of scientific methods for the detection of the criminal, notably the use of ultra-violet light.

Much of the book has been rewritten, related chapters having been combined and a considerable amount of new matter has been incorporated, particularly in the chapters on bloodstains, clothing, documents, explosives and explosions. The expansion of the chapter on firearms, cartridges and projectiles well illustrates the growing importance of this subject due to the greatly increased use of firearms for criminal purposes since the War. Excellent bibliographies accompanying each chapter and numerous references in the text enhance the value of a well-written and up-to-date book, which may be read with interest even by those who are not experts in forensic chemistry.

To the general reader it will enforce the conclusion drawn by the author in his introduction—"the criminal is becoming so scientific not only in his work but in the means he adopts to escape detection, that a scientist is needed to cope with him". The scientific reader will mark that from yet a further point of view his services are urgently demanded by society.

A Text-Book of Organic Chemistry. By Prof. Dr. Julius Schmidt. English edition by Dr. H. Gordon Rule. Second edition, revised and extended. Pp. xxiv + 843. (London and Edinburgh: Gurney and Jackson, 1932.) 25*s*. net.

WE learn from the preface that the two-fold purpose of the author in revising the text of the first edition was to incorporate the main advances which have been made in the subject and to avoid any appreciable increase in the size of the book. An analysis of the distribution of the 45 pages that measure the increase in the size of the book affords a very fair estimate of the conspicuous success with which the author has achieved his object; for 29 pages go to the general section, 8 to the text dealing with the systematic treatment and 8 to the index.

The large extension in the general section enhances considerably the value of the book, for it includes discussions on such subjects as addition to conjugated systems, the electronic theory of valency, the mechanism of racemisation, epimerisation, conditions for enantiomorphism, isomerism due to restricted rotation around a single bond, asymmetrical decomposition, spiro-compounds, the stereochemistry of nitrogen and sulphur, the Beckmann re-arrangement, tautomerism, the parachor, polar properties of organic compounds and factors influencing the magnitude of optical rotatory power. All these subjects are treated with admirable clearness and supplied with full bibliographical references, and certain of them—the one dealing with tautomerism in particular—are valuable monographs on the subjects.

In the text dealing with the systematic treatment, the whole subject has been carefully revised and brought up to date, and the increase of only 8 pages in this section affords no measure of the extent or completeness of this work. For such a measure we turn to the index, in which an increase of 8 pages represents some 360 and 600 new names of authors and subjects respectively.

Die Tierwelt der Nord- und Ostsee. Begründet von G. Grimpe und E. Wagler. Herausgegeben von G. Grimpe. Lief. 21. Teil 1.d$_2$: *Einführung in die Hydrographie der Nord- und Ostsee*, von Bruno Schulz; Teil 2.g: *Sporozoa*, von Eduard Reichenow. Pp. 45 - 88 + 88. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932.) 12 gold marks.

THE latest portion of this useful work begins with a concise and good general account of the hydrography of the North Sea and Baltic, with charts and diagrams, occupying forty-four pages. The remaining eighty-eight pages are taken up by a treatise on the Sporozoa. Omitting the Sarcosporidia as only occurring in the muscles of land vertebrates, Dr. Reichenow divides the group into Telosporidia, Cnidosporidia and Haplosporidia. Most of the known forms belong to the Telosporidia, a fair number to the Cnidosporidia and only a very few to the Haplosporidia. Marine Sporozoa are found in various worms, especially polychætes, in echinoderms, molluscs, crustaceans and tunicates, besides several in fishes. The author wisely places in his lists many species which have not yet been found in the area dealt with, but as they occur in the Mediterranean, parts of the English Channel and the west of Scotland, the distribution may easily extend farther and their inclusion adds much to the value of the work. This also applies to the general account of the structure and biology which covers all these species and not only those so far found in the North Sea and Baltic. Good descriptions and figures are given and the life-histories of many forms are illustrated.

The whole group is extraordinarily interesting and one in which there is still a large amount to be still discovered. Among the Haplosporidia is the unusual case of a sporozoon (*Anurosporidium pelseneeri*) contained in trematode sporocysts of two genera which themselves parasitise the mollusc *Donax trunculus*.

A Manual of Clinical Laboratory Methods. By Dr. C. L. Cummer. Third edition, thoroughly revised. Pp. xx-17-585. (London: Henry Kimpton, 1931.) 30*s*. net.

THE third edition of Prof. Cummer's manual maintains the high standard of the former, and the same policy of conciseness is apparent in the new material which has been introduced. Perhaps the most important additions are the more detailed description of Kahn's reaction for the diagnosis of syphilitic infection, and a full technique for the carrying out of Kline's reaction for the diagnosis and exclusion of syphilis. Among other recently developed tests in biochemistry mentioned are the erythrocyte sedimentation rate, Ehrmann's alcohol test meal, the use of histamine as a gastric juice stimulant, and agglutination tests for tularemia and undulant fever. The Queckenstedt test for sub-aracknoid block is described, but its interpretation is very loosely worded. The author also includes now the long-established Alzheimer method for identifying different types of cells in the cerebrospinal fluid, and the silver staining for treponemata.

This book can confidently be recommended to biochemists and laboratory workers as containing almost everything required for routine work. For the next edition the author might consider including details of blood calcium estimation, and possibly methods of estimating phosphate and lecithin in the blood. For blood cholesterol, also, an all-glass method of percolating the thimble is preferable to that still included.

Origin of Tektites

By Dr. L. J. SPENCER, F.R.S.

SMALL, curiously shaped pieces of green, brown, or, more usually, black glass have long been known from certain regions, and have been called moldavites from the Moldau River in Bohemia and from Moravia; australites or obsidianites from Australia; billitonites from the tin-bearing gravels in the island of Billiton, Dutch East Indies; and Darwin glass from Tasmania. They have also recently been found in some abundance in French Indo-China and in the Philippine Islands. In chemical composition they are peculiar in containing a very high percentage of silica (SiO_2, 70–89 per cent).

Many theories have been advanced to account for the origin of these bodies, which are known collectively as tektites. Those from Bohemia and Moravia were formerly thought to be relics from a prehistoric glass factory. They have been thought to be 'bombs' or bubbles shot out from volcanoes (even from volcanoes on the moon). The fusion of atmospheric dust or desert sand by lightning has been suggested. Another theory is that they are colloidal bodies formed by the action of humic acids on the underlying rock in certain climates. The view most generally accepted at the present time is that they are meteoric, although they are entirely different in all their characters from any meteorite that has been actually observed to fall.

In a recent elaborate and beautifully illustrated monograph[1] Prof. A. Lacroix gives a detailed review of the whole question. He elaborates a suggestion first made by H. Michel in 1925 that tektites have been formed in the earth's atmosphere from meteoric material consisting of the element silicon and the lighter metals (aluminium, calcium, potassium and sodium). Such material heated by friction with the air would rapidly oxidise with the production of a temperature sufficient to fuse the products of oxidation; and subsequent rapid cooling would yield a glass.

Although much has been written on the subject of tektites, the elementary fact that the material of which they are composed is really an impure silica-glass has been entirely overlooked. Pure silica-glass has a specific gravity of 2·20 and refractive index 1·46—both low values. The values for tektites are 2·27–2·51 for the specific gravity and 1·48–1·52 for the refractive index.

Now the 'cinders' of the legendary city of Wabar, 'destroyed by fire from heaven', which was discovered early this year by Mr. H. St. J. Philby in the Rub' al Khali, Arabia,[2] consist of such a silica-glass. The vesicular white glass contains SiO_2, 92·88 per cent, with specific gravity 2·10 and refractive index 1·468; whilst the black glass, almost free from bubbles, contains SiO_2, 87·45 per cent, with specific gravity 2·24 and refractive index 1·50. The black glass contains also Fe_2O_3, 0·28; FeO, 5·77; NiO, 0·35 per cent. At this spot pieces of meteoric iron were found, the largest rusted remnant weighing 25 lb.; and also a series of craters that must have been formed by the impact of a shower of large meteorites. When a large mass of iron travelling with planetary velocity is suddenly stopped, the kinetic energy ($\frac{1}{2}mv^2$) is transformed into heat at a localised spot with the development of a very high temperature. The 'bombs' of silica-glass collected by Mr. Philby at Wabar suggest there must have been a pool of molten silica in the desert sand and that this material was shot out from the craters through an atmosphere of silica, iron, and nickel vapours.

At the group of meteorite craters discovered in 1931 near Henbury in Central Australia[3] silica-glass has also been found, but in smaller quantity and only around the largest crater. Here the country-rock is a ferruginous sandstone and the glass that resulted from the fusion of this rock is black and less pure. It contains SiO_2, 68·88 per cent and has specific gravity 2·31 and refractive index 1·545. It also contains Fe_2O_3, 8·46; FeO, 7·92; NiO, 0·28 per cent. Nickel is not shown in analyses of tektites, probably because it was not suspected and not looked for.

The pieces ('bombs') of silica-glass from both Wabar and Henbury present many similarities to tektites; especially to the Darwin glass from Tasmania, with which some can be matched exactly in both form and appearance. Beads and tear-shaped drops are common and there are some disc-shaped pieces, but none with the perfect button-like shape of true australites. I have been much struck with this similarity, but now that I have seen pictures of the tektites from Indo-China given by Prof. Lacroix in his monograph, I have no hesitation in concluding that tektites are not meteoric, though they are connected with the fall of large meteoric masses, but that they have resulted from the fusion of terrestrial rocks, especially in sandy deserts, by the heat so developed.

Silica-glass and tektites could, of course, be formed only in very exceptional circumstances. The fall of very large meteorites on the earth's surface is fortunately not of frequent occurrence. With the possible exception of the still debatable Siberian fall on June 30, 1908, none has in fact taken place during historic times. Further, the terrestrial rock at the place of fall must be of the right kind, such as sandstone or quartzite, or perhaps best of all a clean desert sand. The composition of tektites indicates that a certain amount of felspar, mica, or clayey material was present in the rock (arkose or siltstone); and no doubt these extra constituents (Al_2O_3, 12; CaO, 3; K_2O, 2; Na_2O, 1 per cent) gave to the molten material just the right viscosity for it to assume particular shapes when spinning through the air after being shot out by the gaseous explosion from the meteorite crater. The craters, supposed to be meteoric, on the Island of Oesel in Estonia are in dolomite, while the rocks in the region of the Siberian fall are basaltic. In neither of these places could silica-glass and tektites be formed.

Silica-glass is very resistant to chemical action and it will withstand weathering processes longer than many other materials. Also, with its very low coefficient of thermal expansion, it will not be affected by changes in temperature—a very potent agent of rock disintegration in desert regions. For this reason tektites are preserved in recent deposits, such as the glacial deposits of Tasmania, the alluvial deposits of Bohemia, Indo-China, and the Philippine Islands, and in the tin-gravels of Billiton, where by slow chemical corrosion they have acquired a peculiar sculptured surface. The australites found on the surface of the Australian deserts do not show this surface sculpturing and are more perfect in form. They are therefore of more recent origin. An aerial survey of the districts where australites are found would probably reveal the presence of meteorite craters with associated large masses of meteoric iron. In the other districts, all traces of the craters would probably have been obliterated by denudation, and the meteoric iron rusted away.

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[1] "Les Tectites de l'Indochine." By Prof. A. Lacroix. *Arch. Mus. Nat. Hist., Paris*, 8, 139, 1932.

[2] NATURE, 129, 932, June 25, 1932.

[3] NATURE, 129, 781, May 28, 1932.

Recent Research on the Vitamins

ADVANCES in our knowledge of the chemistry of the vitamins have recently been so rapid that a review of the position at any moment may require correction or amplification almost as soon as it is published. A useful summary of our knowledge of the nature and function of vitamins was provided in April and May of 1932 by Prof. J. C. Drummond in his Cantor lectures.[1] Some of the points made by the author may be briefly referred to here, and opportunity taken at the same time to review work which has been published since the delivery of the lectures.

Prof. Drummond summarises some of our knowledge in tabular form: the charts showing the minimum effective doses of the different vitamins in test animals, the functions and properties of the six B vitamins, and the distribution of the vitamins in foods are specially useful. He considers first the water-soluble vitamins C and B. The work of O. and A. Rygh and P. Laland[2] on the antiscorbutic potency of narcotine derivatives has not been confirmed by S. Smith and S. S. Zilva[3]. Daily doses of 1·37, 2·75 and 5·5 mgm. of dimethyl and methyl*nor*narcotine had no protective effect in guinea pigs kept on a scorbutic diet. It is possible that the doses were incorrectly chosen as Rygh *et al.* state that only optimal doses prevent the onset of scurvy in guinea pigs on a scorbutic diet. On the other hand, the fact that all Rygh's animals given narcotine derivatives died like the controls indicates that these supplements are not acting in the same way as a daily dose of lemon juice.

Negative results have been described also by other observers, including L. J. Harris and I. Mills, who found that irradiated narcotine and methyl*nor*narcotine were not antiscorbutic in doses ranging from 10 mgm. to 0·001 mgm. daily.[4] Zilva[5] and his colleagues have recently published full details of their work. No narcotine could be isolated from unripe orange juice by ethereal extraction, nor was a concentrate of vitamin C obtained from lemon juice by such means. Methyl*nor*narcotine in daily doses ranging from 10 γ to 2·7 mgm. had no antiscorbutic effect at all in guinea pigs maintained on a scorbutic diet, the experimental animals dying in 30–35 days with all the signs of severe scurvy.

Reference has already been made in these columns to the claim that vitamin C is a hexuronic acid[6]. The experiments on which the claim is based have now been published in detail.[7] Svirbely and Szent-Györgyi found that 1 mgm. of their product daily completely protected guinea pigs on a scorbutic diet from scurvy for 90 days: the animals also showed normal growth during this period. The minimum protective dose of lemon juice is usually regarded as 1·5 c.c. and this quantity contains approximately 0·5 mgm. of the acid. Since the substance contains a molecule of water less than is required for a hexuronic acid, Szent-Györgyi and W. N. Haworth have now suggested the name "ascorbic acid" for it (NATURE, 131, 24; 1933). Waugh and King have also isolated a crystalline solid from lemon juice which was protective in a daily dose of 0·5 mgm. The possible objection that the material isolated from lemon juice was merely contaminated with a more potent antiscorbutic substance is not valid in the case of the work of the former authors, since the acid used was prepared from ox suprarenal glands. If the antiscorbutic factor is ascorbic acid, it is necessary to explain Zilva's observation that it is possible to oxidise the reducing factor in lemon juice without destroying the antiscorbutic potency, although the vitamin is now very labile: Svirbely and Szent-Györgyi suggest that in these conditions the acid may be present in a reversibly oxidised state. The antiscorbutic potency of this acid has been confirmed by Harris and Mills (*loc. cit.*), who also found raw suprarenal cortex potent, the activity running parallel to the acid content.

Turning to vitamin B, Prof. Drummond reviews the work of Jansen and Donath, Odake, and Windaus and his co-workers on the chemistry of vitamin B_1.[8] All observers now agree that the crystalline vitamin contains sulphur in its molecule, as well as carbon, hydrogen, oxygen and nitrogen.

H. W. Kinnersley, J. R. O'Brien and R. A. Peters, in a recent communication,[9] also confirm this observation: their crystals were obtained from bakers' yeast, and the hydrochloride is active in a pigeon day dose of 2–4 γ (a pigeon day dose is approximately equal to 1·5 vitamin B_1 international units). Windaus's preparation is active on pigeons in doses of 1·4–3·3 γ: both are more active than Jansen and Donath's original preparation, which contained also vitamin B_4.

Vitamin B_1 is usually considered to be a base. Examination of a number of bases for antineuritic or growth promoting powers has, however, so far given negative results. B. C. Guha and P. N. Chakravorty have recently announced in these columns[10] that irradiation of adenine sulphate with ultra-violet light confers vitamin B_1 properties upon it. In this connexion work on the absorption spectrum of vitamin B_1 concentrates has some interest: a band at 2600 A. was found by Guha[11], Windaus (*loc. cit.*) and others. F. F. Heyroth and J. R. Loofbourow have recently reviewed the question and reported some experiments of their own.[12] The absorption spectrum of yeast nucleic acid shows a band of maximum absorption near 2600 A., suggesting that vitamin B_1 concentrates contain purine or pyrimidine compounds. Irradiation of uracil or thymus nucleic acid increased the absorption between 2300 and 2550 A. No decrease in the absorption at 2600 A. was observed when only wave-lengths longer than 2960 A. were used for the irradiation. After irradiation, uracil and adenine develop a blue colour with arsenophosphotungstic acid, similar to that given by vitamin B_1 concentrates. Heyroth and Loofbourow found a fairly close correlation between potency and absorption at 2600 A. in the purest concentrates examined. Compounds which are likely to absorb in this region are those containing a pyrimidine-ring or those closely related to ergothioneine (betaine of thiolhistidine). This suggestion is of interest in view of the fact that vitamin B_1 is now held to be a sulphur compound.

It appears likely that pure crystalline vitamin B_1, prepared synthetically, will be available in the near future, as pure crystalline vitamin D is available to-day. Meanwhile, the animal test must be the final criterion. To ensure comparable results in different laboratories, the Permanent Commission on Biological Standardisation of the League of Nations has recommended the issue and use of a fuller's earth adsorbate from rice polishings as a standard for vitamin B_1, 10 mgm. of which is defined as containing one unit. H. Chick and H. M. Jackson[13] report on the use of this preparation. It has been found stable for a year, its vitamin B_2 content is only 1/25–1/50 of the vitamin B_1 present and it also contains vitamin B_4.

Prof. Drummond referred briefly to the recent work on the physiology of vitamin B_1 and emphasised the importance of distinguishing between the changes due to inanition and those caused by a deficient intake of vitamin B_1 *per se.* N. Gavrilescu and R. A. Peters[14] have found that the oxygen uptake of parts of the brain in pigeons suffering from polyneuritis is definitely below normal. Administration of vitamin B_1 to the birds or its addition to the minced brain tissue *in vitro* resulted in an increase in its consumption.

Prof. Drummond also summarised our knowledge concerning vitamin B_2. He considers that it is a neutral and not a basic substance, with a molecular weight greater than that of vitamin B_1.

Some recent work on vitamin B_4 may also be mentioned here. Absence of this vitamin from the rat's diet produces redness and swelling of the paws, a spastic gait and loss of co-ordination. Convulsions and paralysis are the characteristic signs of vitamin B_1 deficiency.[15] H. Barnes, J. R. O'Brien and V. B. Reader[16] describe the preparation of a crystalline compound with vitamin B_4 activity, having the empirical formula $C_4N_4H_6Cl$. It was obtained from yeast extract by adsorption on charcoal at *p*H 1. The charcoal was extracted with 50 per cent acid alcohol, the alcohol removed *in vacuo* and the extract subjected to successive treatments with mercuric sulphate, baryta, sulphuretted hydrogen and sodium phosphotungstate. A crystalline phosphotungstate was precipitated at *p*H 2 and recrystallised from 50 per cent alcohol. It was then dissolved in 50 per cent acetone, and the phosphotungstic acid removed with baryta; the acetone was removed from the filtrate, which was hydrolysed with 5 per cent hydrochloric acid: the solution was concentrated and alcohol and ether added. Crystals were deposited, with melting point 248° (with charring).

Although highly potent preparations of vitamin A have recently been obtained, it has not been found possible to crystallise them. Prof. Drummond refers to the recent work of Karrer, Morf and Schopp, suggesting that vitamin A is an unsaturated alcohol, having the empirical formula $C_{20}H_{30}O$ or $C_{22}H_{32}O$, its structure being related to half the carotene molecule.[17] I. M. Heilbron, R. A. Morton and E. T. Webster[18] have confirmed this suggestion. A concentrate was heated with finely powdered selenium at 300°–330° for 48 hours, and the product extracted with ether. After removal of the solvent, the oil was distilled over metallic sodium; the fraction distilling at 120°–200°/20 mm. was treated with picric acid, when the orange crystals of 1 : 6–dimethyl naphthalene picrate were obtained.

I. M. Heilbron, R. N. Heslop, R. A. Morton, E. T. Webster, J. L. Rea and J. C. Drummond[19] have described the properties of the most concentrated preparations of vitamin A, which they have recently obtained from halibut liver oil. The unsaponifiable fraction was obtained, freed from sterols and fractionally distilled at a pressure below 0·00001 mm. The main fraction distils at 137°–138°, with increase in potency. It is a pale yellow viscous oil which becomes mobile on warming, and is readily soluble in organic solvents; at 3280 A. $E^{1\text{ per cent}}_{1\text{ cm.}} = 1,350$ and the Carr-Price blue value is about 65,000. The analytical figures agree fairly well with those required for the formula $C_{20}H_{30}O$. Similar concentrates were prepared from sturgeon liver oil and mammalian liver fat, but the best material obtained from cod liver oil was only about half as pure. Biological tests on rats showed that daily doses of 0·025–0·1 γ cured xerophthalmia and promoted growth.

The antimony trichloride test indicates that these concentrates still contain variable quantities of a substance which is chromogenic but is different from vitamin A itself. The blue colours obtained with sturgeon and halibut liver oil concentrates show an absorption band at 6930 A. the intensity of which is usually a quarter of that of the band at 6170 A. but in halibut concentrates may be only one-tenth ; moreover, no selective absorption was observed at 6930 A. in mammalian concentrates. Morton[10] has found that the addition of 7-methylindole to the concentrate inhibits the development of the band at 6170 A. before that at 5830 A. is appreciably affected. In the richest concentrates the intensity of the band at 6170 A. is almost twice that of the band at 5830 A. If 7-methylindole is added to the concentrate in the ratio 4 : 1 (or 10 mol. to 1 mol.) the two bands appear of roughly equal intensity. The band at 6930 A. is not readily inhibited by this reagent. The independence of the two bands at 6170 A. and 5830 A. indicates either that two chromogens are present or that vitamin A reacts with antimony trichloride in two stages.

Reference has already been made in our columns to the possible correlation between the biological test and certain of the chemical and physical characteristics of oils containing vitamin A.[11] Another series of cod liver oils has now been examined and further tests have been performed on some of the previous series.[12] The variations between the different methods were greater than in the earlier series of tests, but it still appears that the intensity of the band at 3280 A. in the oil itself forms the best measure of its biological activity. The antimony trichloride test was not so satisfactory, although in the case of certain oils, when it was carried out on the unsaponifiable fraction of the oil, a correlation was found between the blue value and the biological activity. The biological tests had a large margin of error. It was found advisable to compare a sample with the standard oil in simultaneous tests rather than to rely exclusively on the curve relating growth to dose given obtained with the standard oil at some earlier date.

R. J. Norris[13] has also noted marked discrepancies between the biological and colorimetric methods of assay. The course of the inactivation of vitamin A by irradiation with ultra-violet rays was also followed. An initial latent period was found by biological test but not colorimetrically ; after four hours' irradiation, all the vitamin had been destroyed, but the colour test indicated that the potency had only been reduced about 25 per cent. The destruction of the chromogen follows the course of a bimolecular reaction.

The discrepancies may be explained in part by the error of the biological test and by the presence in oils containing vitamin A of substances which interfere with the development of the blue colour in the Carr-Price test or with its determination. R. S. Morgan[14] has found that the presence of any red in the colour estimated reduces the value of the blue.

The details of the conversion of carotene to vitamin A in the animal body are as yet unknown. The absorption of carotene from the intestine is a slow and incomplete process ; it is apparently related to the fat content of the diet. Small amounts may be found in the liver, but it appears that the bulk of the absorbed material is stored in that organ in the form of vitamin A.[15] The conversion presumably occurs in the liver, but Ahmad was unable to confirm the observation of Olcott and McCann that this organ contains an enzyme which converts carotene into vitamin A *in vitro*. When the diet is rich in carotene, the vitamin A stores in the liver are high. The stores are utilised when the diet is deficient in carotene or the vitamin, but the exact function of the latter in metabolism is unknown. W. J. Dann has shown that it is only with difficulty passed into the mother's milk, so that to build up a store in young animals it is necessary to give it directly to the latter[16] ; also in the rat, at least, very little reaches the young via the placenta. The failure of growth on a vitamin A deficient diet is not entirely due to loss of appetite. Rats on this diet may consume as much food as their litter mate controls given a supplement of vitamin A, but the amount of nitrogen deposited in the body is less and the amount excreted in the urine greater than in the latter, indicating an increase in the nitrogen metabolism. The increase of body-weight per gm. of food eaten is less when the animal has not available an adequate amount of vitamin A.[17] Vitamin A is apparently necessary for the deposition of body tissue. It is well known that certain epithelial surfaces cannot maintain their proper structure when the animal's stores are depleted, with the result that infectious processes develop in different regions of the body. Thus both the growth-promoting and the anti-infective properties of vitamin A appear to depend fundamentally upon its ability to maintain a normal structure in the different tissues of the organism.

The story of the isolation of crystalline vitamin D is now well known and has been referred to previously in these columns.[18] Prof. Drummond reviews the different investigations leading to its isolation in his third Cantor lecture and also refers in considerable detail to Mrs. Mellanby's work on dental caries, which has also been described in NATURE[19]. With the preparation of the pure vitamin, biological tests have become of less importance ; the earlier production of highly active compounds and their use in clinical practice led, however, to a great increase in the number of such tests required, with the result that methods were standardised and their accuracy increased. We have already referred to the analysis of the curative radiographic method given by Bourdillon and his colleagues.[30] Working with Miss Bruce, he has recently completed a comparison of the prophylactic radiographic method with that based on bone analysis.[31] A radiographic scale was prepared showing eight stages from full rickets to normal bone. The relation between scale reading and logarithm of the dose was not linear. With bone analysis, on the other hand, the relation between percentage of bone ash and logarithm of dose was linear between doses of 0·03 and 0·32 unit vitamin D. An analysis of the errors of the different methods leads the authors to the following conclusions: the accuracy attainable is greater with bone analysis than with the use of a radiographic scale, using the prophylactic method, and the range of doses possible is greater; but the method of bone analysis has about the same degree of accuracy as the radiographic when the curative method of dosing is used in the latter instead of the prophylactic. The radiographic method is, of course, much the quicker and more animals can be used for each test. The authors also consider that the chief variations in the sensitivity of a stock fed on a supposedly constant diet are due to some factor other than vitamin D.

The method of bone analysis (with prophylactic dosing) is considered in greater detail by E. M. Hume, M. Pickersgill and M. M. Gaffikin.[32] The linear relationship between percentage of ash in the bones and the logarithm of the dose is only observed when eight or more animals are used on each dose. The exact position of the line depends on the severity of the rickets developed by the animals. The increments for percentage ash are smaller in the less rachitic series of rats, so that the straight lines of the graphs tend to converge to the point 54 per cent ash and 5 units dose.

Analyses of the 'line' test have been carried out by K. M. Key, B. G. E. Morgan and R. S. Morgan,[33] whilst the former authors and K. H. Coward have examined the possibility of using the growth-promoting property of vitamin D in its quantitative determination.[34] Key and Morgan constructed curves relating degree of healing to dose given, using Dyer's scale to assess the degree of healing. This scale is similar to the radiographic scales but has only six stages. Different curves were obtained in accordance with the different degrees of rickets which may be developed by the animals of different experiments. It is recommended that three reference curves be constructed, for slight, moderate and severe rickets respectively, for use in the assay of preparations for their vitamin D potency. The curves were used in an examination of the effects of changing the ratio of calcium to phosphorus in Steenbock's rachitogenic diet: changing the ratio from 4 : 1 to 2 : 1 was equal in effect to a daily dose of 0·7 unit of vitamin D. A knowledge of the effects of changing this ratio may be required when it is necessary to test food materials containing these elements for their content of vitamin D. R. S. Morgan measured the area of calcification in the 'line' test with the planimeter and found that the degree of healing was strictly proportional to the logarithm of the dose between 0·125 and 1·0 unit. Doubling the dose increased the area of calcification by 59 sq. mm. using a magnification from line to drawing of 11 diameters. With 10 pairs of rats, the probable error of a test is ± 7 per cent: this is less than with the radiographic method since the error in the diagnosis of healing is eliminated. The chief source of error is the variable response of litter mates to a given dose.

It is of interest to note that Coward, Key and Morgan found that there is also a linear relationship between the growth response of rats and the logarithm of the dose given. The animals were kept on the standard vitamin A-free diet without vitamin D. Vitamin A was supplied in the form of carotene. The growth method gives the same results as the line test, but is more laborious and probably less accurate. The growth response to vitamin D is less than that to vitamin A on the same diet.

In conclusion, it may be mentioned that Prof. Drummond considered some of the illnesses which may result from a deficient intake of the different vitamins. It is difficult to estimate how far minor disorders may be due to this cause in Great Britain to-day. It would be of great interest to carry out a dietary survey, on the lines of previous surveys dealing with the protein, fat and carbohydrate intake, but investigating the consumption of vitamin-containing foods, so that the vitamin requirements of the population might be more accurately estimated.

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[1] *J. Roy. Soc. Arts*, 80, 949, 959, 974 and 983; 1932.

[2] See also NATURE, 129, 288; 1932.

[3] *Chem and Ind.*, 51, 166; 1932.

[4] *Lancet*, (2), 235; 1932.

[5] R. L. Grant, S. Smith and S. S. Zilva: *Biochem J.*, 26, 1628; 1932.

[6] NATURE, 129, 576, 690, and 943; 1932.

[7] J. L. Svirbely and A. Szent-Györgyi; *Biochem. J.*, 26, 865; 1932: W. A. Waugh and C. G. King; *J. Biol. Chem.*, 97, 325; 1932.

[8] See also NATURE, 129, 161; 1932.

[9] *J. Physiol.*, 76, 17*P*; 1932.

[10] NATURE, 130, 741; 1932.

[11] *Biochem. J.*, 25, 931; 1931.

[12] *Bull. Basic Sci. Res.*, 3, 237; 1931: 4, 35; 1932.

[13] *Biochem. J.*, 26, 1223; 1932.

[14] *Biochem. J.*, 25, 1397 and 2150; 1931.

[15] V. Reader: *Biochem. J.*, 24, 1827; 1930.

[16] *J. Physiol.*, 75, 8*P*; 1932.

[17] See also NATURE, 129, 88; 1932.

[18] *Biochem. J.*, 26, 1194; 1932.

[19] *Biochem. J.*, 26, 1178; 1932.

[20] *Ibid.*, 1197.

[21] NATURE, 129, 514; 1932.

[22] K. H. Coward, F. J. Dyer, and R. A. Morton: *Biochem. J.*, 26, 1593; 1932.

[23] *Bull. Basic Sci. Res.*, 3, 89 and 249; 1931.

[24] *Biochem. J.*, 26, 377; 1932.

[25] T. Moore: *Biochem. J.*, 25, 275; 1931: B. Ahmad, *Ibid.*, p. 1195.

[26] *Ibid.*, 26, 1072; 1932.

[27] M. M. Sampson, M. Dennison, and V. Korenchevsky: *Biochem. J.*, 26, 1315; 1932.

[28] NATURE, 129, 178; 1932.

[29] NATURE, 129, 88; 1932.

[30] NATURE, 129, 514; 1932.

[31] R. B. Bourdillon and H. M. Bruce: *Biochem. J.*, 26, 506; 1932.

[32] *Ibid.*, 488.

[33] *Biochem. J.*, 26, 196; 1932: and R. S. Morgan: *Ibid.*, 1144.

[34] *Ibid.*, 1585.

Obituary

MR. C. F. BEADLES

CECIL FOWLER BEADLES, pathological curator of the Hunterian Museum at the Royal College of Surgeons, whose death at the age of sixty-six years occurred on January 3, received his medical education at University College and Hospital, London, where he gained honours in histology. In 1890 he obtained his diploma and afterwards passed two years as senior house surgeon at the Cancer Hospital; there he was enabled to perfect himself in microscopical technique and pursue the study of pathological anatomy, the branch of medical science towards which his natural inclination turned.

Mr. Beadles's subsequent career falls into three periods defined by the posts which he successively occupied, namely, those of assistant medical officer at the London County Asylum, Colney Hatch, assistant to Prof. Shattock, then curator of the Hunterian Museum, and finally pathological curator of the Museum. While at the London County Asylum, he was constantly engaged in scientific studies relating both to mental disease and to pathological anatomy generally. Most of his published works at this time were contributed to the *Transactions of the Pathological Society*, which contain no less than forty-five papers from his pen. He communicated a few papers to the Medico-Psychological Association, of which he was a member and from which he received a prize and bronze medal in 1894 for a dissertation on degenerative lesions of the arterial system in the insane. He interested himself particularly in the vascular supply of the brain, the anatomical variations and anomalies of which he considered might have a bearing on mental disease and on the clinical signs of such conditions as embolism.

The results of Mr. Beadles's researches in this direction were embodied in the Hunterian lecture which he delivered at the Royal College of Surgeons in 1907–8. He contemplated writing a book on the subject which should include the literature, and he collected a great number of extracts from British and foreign sources for this purpose. However, the War intervened and his subsequent ill-health prevented him from resuming the work.

In 1909 Mr. Beadles became assistant to Prof. Shattock, who was then engaged on the revision of the pathological catalogue of the Hunterian Museum, and he continued to be connected with the Museum up to the time of his death, a period of more than twenty years. At the outbreak of the War he was appointed, under Government, to deal with the pathological war material which was accumulated at the Royal College of Surgeons. This was an arduous undertaking involving the examination, preparation, and dissection of a vast number of specimens, their selection to form a fully illustrative series of the injuries and diseases incidental to warfare, their mounting and suitable display. The collection thus formed now constitutes a separate and important section of the Hunterian Museum, consisting of about three thousand specimens; and it will remain as a standing memorial to the honour of Mr. Beadles.

The final period of Mr. Beadles's career, that of the curatorship, is mainly one of steadily declining health. When he succeeded to Prof. Shattock in 1925 he was already afflicted with bronchial and pulmonary trouble. The commencement of this he considered to have dated from the time of his work on the war material, and it is quite possible that the inhalation of the vapour of formalin to which he was constantly exposed at that time was responsible for his illness, although his ill-health was aggravated by other complications. His untiring energy and devotion to museum work, however, did not desert him even to the end, although the work became an obvious burden.

Mr. Beadles was a pure pathological anatomist of a type now gradually disappearing amid the experimental tendencies of the time. He was entirely absorbed in his subject, beyond which he had but few interests, and he lived a life of absolute seclusion. The well-merited honour of the fellowship of the Royal College of Surgeons was conferred upon him shortly after his promotion to the curatorship.

PROF. R. DONALDSON

PROF. ROBERT DONALDSON was a man of very great culture. Before commencing his medical studies, he took an arts course in the University of Edinburgh and graduated M.A. in 1899. In 1904 he obtained his M.B., Ch.B., and the same year received the diploma in tropical medicine. He gained his fellowship of the Royal College of Surgeons of Edinburgh in 1908, the diploma of public health in 1912, and his M.D. degree with honours in 1918.

Donaldson commenced his pathological career as assistant with me in the University of Sheffield. From there he went as assistant to Prof. Walker Hall in the University of Bristol. Later he was appointed pathologist to the Royal Berkshire Hospital, Reading, where, during the War, he was specialist officer in charge of the laboratory. From Reading he went to St. George's Hospital as lecturer in pathology and in forensic medicine, and in 1928 he was appointed to the Sir William Dunn chair of pathology tenable at Guy's Hospital.

Dr. Donaldson took a very active part in research work, and his knowledge of modern languages was a great help to him. The mass of routine work which falls to the lot of a lecturer and professor in departments which are inadequately staffed—and this seemed always to be Donaldson's lot—limited his output of published work; but his knowledge of the subject which he taught—and he was a great teacher—is evidenced in his excellent book on morbid anatomy, of which the second edition appeared only last year.

Dr. Donaldson had wide interests outside his department. He was a Scot with all the keenness for knowledge which is so characteristic of his countrymen. He loved his native land, and he had a wide knowledge of its customs, its songs and its language. His wanderings in the Highlands and Islands inspired him to learn Gaelic. He was a man of deep religious convictions, and his home life was an inspiration to many. Those of us who knew him regarded him as a great pathologist and teacher, we welcomed him as a colleague, but we loved him as a man, and, as one of his greatest friends has said of him, "Allied to a keen analytical intellect was a heart of the warmest emotions". To his wife and his two daughters we tender our heartfelt sympathy.

J. M. BEATTIE.

DR. MALCOLM E. MACGREGOR

IT is with regret that we have to record the death at the early age of forty-three years of Dr. Malcolm Evan MacGregor, who was in charge of the Wellcome Entomological Field Laboratories at Esher, Surrey. Born in South Africa, he studied at Cambridge and later as a Carnegie fellow at Harvard, where he came under the influence of Dr. L. O. Howard, and decided to study the medical aspects of entomology. He first came into prominence during the War when he served with the R.A.M.C. in East Africa in connexion with mosquitoes and other insect carriers of disease. From East Africa he was invalided home, and on recovery was placed in charge of a War Office Research Laboratory at Sandwich to study mosquitoes in their relation to the spread of malaria in Great Britain from returned soldiers carrying the disease.

After the War, MacGregor took charge of the Entomological Field Laboratory founded by Sir Henry Wellcome. Here he continued his studies of mosquitoes, particularly with the view of solving some of the fundamental problems underlying their mode of life, feeding, hibernation and reproduction. For a period, these researches were interrupted by a visit to Mauritius on behalf of the Colonial Office, to study the mosquito-malaria problem. A valuable report was the result, and it was shown that a second important malaria-carrying mosquito occurred in Mauritius, namely, *Anopheles funesta*, which had been overlooked both by Sir Ronald Ross and Sir Andrew Balfour during their visits to the island.

On his return to England, MacGregor resumed his mosquito studies. He showed that the diverticulum, a sac which opens into the œsophagus of the mosquito, is a kind of reservoir into which the mosquito can direct at will or by reflex action fluids unsuitable for the stomach. He studied the extraordinary effect of ultra-violet rays on the larvæ, the various reactions of waters in which they occurred, and strove to establish the fact that the larvæ of culex and anopheles mosquitoes live in waters of different but particular hydrogen ion concentration. Latterly, he had been studying a so-called autochtonous race of *Culex pipiens*, a race which is able to complete its life-cycle without any blood meal and does not hibernate.

MacGregor's death at the height of his scientific career is nothing short of a tragedy, inflicting a serious loss upon the science of medical entomology. He was the author of numerous scientific papers dealing with the subjects of his particular study, and of a book entitled "Mosquito Surveys".

News and Views

Gold in Kenya and Native Reserves

THE memorandum issued by the Colonial Office on the position in Kenya in relation to the leasing of lands in native occupation on native reserves for mining purposes cannot be regarded as satisfactory. It affords no guarantee that the more objectionable consequences of the amendment of the Ordinance will not ensue. For example, while admitting that "the matter of immediate importance is to ensure that any individual native . . . shall receive compensation and an alternative piece of ground on which he may live and work in proximity to his market", it states that the Governor "does not contemplate any difficulty in providing individual dispossessed natives with land". But when the amendment was introduced, and also when it was discussed in the House of Commons, it was stated definitely that the reason for payment of a money compensation was that land could not be provided for all the natives who, it was anticipated, would be dispossessed. Nothing is said of the terms of tenure of the land on which the dispossessed natives will be settled, a matter of the first importance in tribal organisation, as has already been pointed out in NATURE.

THE Chief Native Commissioner himself, in introducing the amendment, stated that the natives would not lease their lands voluntarily and that their "most sacred traditions" would be violated by "removal from their own land on which they had the right to live, and setting them up on another piece, the owners of which had the right to eject them". No attempt is made to meet this difficulty. As the explanatory memorandum issued to natives had been circulated before the Chief Native Commissioner made his statement, it is therefore to be presumed that it did not assuage native feeling in this matter. Yet every anthropologist is well aware that it has been through neglect of susceptibilities of this character that our Colonial administrations have been involved in innumerable difficulties and even, in some instances, in native risings. The small area which may be required on any given holdings, and the temporary character of the exclusion, both points which are stressed, are irrelevant. There are other points in which the memorandum of the Colonial Office falls short in facing the difficulties of the situation. These cannot be discussed within the compass of a brief note; but it is evident that further deliberation is a vital necessity.

George Edwards, F.R.S.

AN illustrated article by Mr. T. E. James in the first quarterly issue of *Science Progress* for 1933 recalls the work and interests of George Edwards, an eighteenth century naturalist (1694-1773) and Copley medallist in 1750 of the Royal Society. Edwards was made library-keeper of the Royal College of Physicians in 1733, on the recommendation of Sir Hans Sloane, its president, remaining in office at Warwick Lane for thirty-six years. During that period he devoted himself to the portrayal in colour of birds, quadrupeds and fishes (mostly new to science) from actual specimens. The Linnean Society has recently received from Major V. Seymer a set of Edwards's works, containing annotations and memoranda by a contemporary and correspondent of Edwards, namely, Henry Seymer, of Hanford, Dorset. It may be of interest to mention that the Linnean Society already possessed copies of Edwards's works, these having originally belonged to Joseph Grote, a collector of rare books on natural history and botany. At his death in 1805, his brother inherited his property, and ultimately the books, with many fine engravings, passed into the ownership of George Grote, the historian. His widow gave the greater portion of the collections to University College, London. Mrs. Grote reserved, however, the works by Edwards, but in 1877 placed them at the disposal of Sir Joseph D. Hooker, whom she designated as "the worthy and distinguished president of the Royal Society". In the end, Sir Joseph gave the books to the Linnean Society.

Arthur Woolf, 1766–1837

ONE of the most interesting chapters in the history of the steam engine is that relating to the Cornish pumping engine. Early in the eighteenth century, Newcomen engines were installed for pumping at the Cornish mines, and in 1777 these began to be superseded by the low-pressure condensing engines of Boulton and Watt, which required much less coal. While the mines gained greatly by the use of the latter, the all-embracing patent of Boulton and Watt prevented other inventors from putting their ideas into practice. The expiry of this patent in 1800 was a boon to the whole county and through the work especially of Woolf and Trevithick, the pumping engine of the nineteenth century proved as superior to the Boulton and Watt engines as the latter had been superior to the Newcomen engines. Of Trevithick's work a great deal will be said at the forthcoming centenary celebrations, while of Woolf's work a review was given in a paper entitled "A Cornish Engineer, Arthur Woolf, 1766–1837", read to the Newcomen Society by Mr. Rhys Jenkins on January 18. The first great improvement due to Woolf and Trevithick was the use of steam pressures up to 40 lb. per sq. in., while Woolf was one of the pioneers of the compound engine. Like all their contemporaries, these engineers worked at a time when the caloric theory still held sway, and they were quite ignorant of the true theory of heat. Carnot, however, in his famous essay of 1824, referred to Trevithick and Woolf as being among the veritable creators of the steam engine, and it is as such they will be remembered.

British Science Guild Research and Development Lecture

THE Council of Management of the British Science Guild, at a meeting held on January 19 last, decided to establish an additional lecture to be known as the Research and Development Lecture. The main object of this annual lecture, which will be delivered in London in April or May, is to promote attention to the importance of research—both purely scientific and technical—and the utilisation of its results in the service of mankind. The increase of knowledge thus secured has direct relationship with industrial development, the daily needs of the community, economic principles and social problems, human welfare and progress as well as methods of thought and the trend of civilisation. Each lecturer will be asked to select from his own particular field suitable examples of contacts with any of these factors of progressive thought. In establishing the lecture, the British Science Guild associates it with the name of Sir Richard Gregory and his work as editor of NATURE in securing increased recognition for scientific work and scientific workers in national life and in international affairs. The first of these research and development lectures will be given in May by Sir Harold Carpenter on "Metals in Industry".

Papal Observatory in Castel Gandolfo

HIS HOLINESS POPE PIUS XI has shown himself a frequent patron of science. On the occasion of the official opening of the new academic year at the Papal Academy of Science, in the presence of the Pope, Dr. Joh. Stein, S.J., who has succeeded the late Father Hagen as director of the Papal Observatory, announced, as reported in the *Osservatore Romano* of December 19–20, that the Papal Observatory is to be moved from the Vatican to Castel Gandolfo, where it is to be rebuilt on a much larger scale. Castel Gandolfo is an old summer residence of the Popes, which has been returned to them by the Italian Government according to the terms of the Lateran Treaty and is being thoroughly restored. Joined to this historic building, a new observatory with the most modern equipment is to be constructed at the Pope's instructions, with easy access from the State apartments for his convenience during his summer visits to Castel Gandolfo. The contract for the supply of the instruments has been placed with Messrs. Carl Zeiss, Jena. The equipment includes two domes of about 8½ m. diameter, a large double astrograph with a 400 mm. refracting and a 600 mm. reflecting camera, a co-ordinate measuring apparatus, a spectrograph, several objective prisms, a Blink comparator and an astro-wedge-photometer, as well as a new refractor-mounting for an existing telescope objective. The domes will each be equipped with an observation platform of the latest type, the so-called tilting platform, which is moved by electric motors controlled by switches within easy reach of the observer. On these sliding platforms the observer can easily follow any movement of the telescopes. The instruments and apparatus are to be supplied within two years.

Crystals of the Living Body

THE first Friday evening discourse of the new session was delivered at the Royal Institution on January 20 by Sir William Bragg, who chose as his subject "The Crystals of the Living Body". Growth and purpose require directed arrangement of the protein or other molecules of which the body is made. The protein of a silk fibre is a long chain-like molecule consisting of a sort of backbone in which two carbon atoms and one nitrogen make the regularly recurring links, and this structure is common to the various forms of protein. Of every pair of carbon atoms one has, so to speak, a spare hook to which other atoms or strings of atoms may be attached, like pendants to the links of a mayor's chain. In the case of silk these pendants are very simple, consisting alternately of a hydrogen atom and a group containing one carbon and three hydrogens. The new methods of X-ray analysis enable us to prove the arrangement of these chains, and to measure the dimensions of the links. They show that the chains tend to group themselves into bundles, and they find the forms which the bundles take. This arrangement is obviously appropriate to the functions of the silk fibre, to its flexibility and its tenacity. The fibre is spun, in fact, just as we spin a rope on a far grosser scale, laying the vegetable fibres side by side. Such a parallelism is no surprise, for in all our examinations of organic substances in the laboratory, physical, chemical, or biological we have always found that our best practice is foreshadowed. A particularly interesting comparison can be made with the structure common to hair, wool, horn, feathers and the like. These are built on the same principle as the other proteins, from which they differ only in the nature of the pendants. The latter in this case attract each other strongly, and in drawing together give the chain a wavy or crumpled form : the process has lately been explained by Astbury. The in-curled proteins, with their internal attractions satisfied, are not susceptible to many reagents which bring about the dissolution of proteins of the extended form. Thus hair long outlasts other parts of the body in their decay.

Synthetic Sound Films

ACCORDING to a report in the *Times* of January 11, an interesting curiosity has been on exhibition in Germany in the form of a sound film "Die Tonënde Handschrift" in which the sound part was originally prepared without the use of sound. Details are not available but from the illustrations it appears that the film uses the contour method of sound recording in which a constant density of blackening is produced over varying widths of the film. Normally this is produced by light reflected on to the moving photographic film from an oscillograph operated by electric vibrations transformed from the original sound vibrations. Herr R. Pfenninger in the new process makes templates each containing several sound waves and photographs a reduced image of these in turn on to the stationary film. Both the preparation of the templates and their photographing naturally take much longer and the object is not to reproduce graphically the tones of well-known musical instruments but to construct music of new timbre. The report states that the laboriousness of preparing the templates is to be reduced by the use of a typewriter which uses wave-outlines instead of letters, a separate sound-wave typewriter being used for each timbre. It would be interesting to know if the characteristic wave-forms of singing or string playing of exceptionally good quality could be successfully copied so as to give reproductions of melodies which had not been actually performed. This might make possible the performance of a new musical work by the voice, or playing, of an artist no longer living.

Migration from and to Great Britain

A PAPER by Mr. H. Leak and Mr. T. Priday on the subject of migration from and to Great Britain was read at a meeting of the Royal Statistical Society on January 17. Factors affecting post-War migration, of which the chief are social insurance, national assistance to emigrants, and the United States quota system, were fully considered and also the main features of post-War migration, particularly in regard to the inter-censal period 1921–31. A comparison of pre-War and post-War migration shows that the annual average of the net outward movement of British subjects from the British Isles to places out of Europe was about 193,000 in the ten years 1904–13 and 112,000 in the years 1921–30. In 1931, however, there was a change from net emigration to net immigration, the excess inward in that year amounting to 37,000, while for 1932 the figure is estimated to be about 50,000. Although, in the future, emigration may be on a considerably smaller scale than in pre-War days, it may still, within the next one or two decades, be on a scale commensurate with the ability of Great Britain to release population of the ages which the Dominions require, regard being had to the diminishing numbers of new entrants into the labour market.

Anomalous Eskimo Vertebræ

SOME suggestive results, which may possibly turn out to have a bearing on the question of the existence of evolutionary tendencies in modern man, emerge from an examination by Dr. T. D. Stewart, of the Smithsonian Institution, Washington, D.C., of skeletal material brought back by one of the Institution's recent expeditions to Alaska. The material consists of some two hundred Eskimo skeletons, which were obtained by excavation. Dr. Stewart's observations point to the possibility that they may prove an exception to the generally accepted view that the human body has attained a high degree of specialisation, which shows little tendency to vary. Approximately 12 per cent of these Eskimo skeletons have 25, instead of the normal 24, presacral vertebræ. The anomaly is present in nearly sixteen per cent of the males, but in only less than one per cent of the females, and it is considerably more frequent in skeletons secured north of the Yukon. In a preliminary report on these results, which has been issued by the Smithsonian Institution, it is pointed out that this frequency is nearly twice as much as the maximum previously recorded among the northern Eskimo. Among Europeans it runs to only 3-6 per cent; but one study notes 7 per cent among the Japanese. In the material examined by Dr. Stewart, the tendency seems to be towards a lengthening of the spinal column from the sacrum. There is no variation in the cervical vertebræ to show a tendency towards the lengthening of the neck. The predominance of the anomaly among males is held to give some indication of a hereditary character. Dr. Stewart's material will appear in full in the *American Journal of Physical Anthropology*.

Research Work of the Metropolitan-Vickers Electrical Co. Ltd.

NOTWITHSTANDING the industrial depression the activities of the Research Department of Metropolitan-Vickers have not been in any way curtailed. The research on the properties of steel at high temperatures is being continued, particular attention being paid to an examination of the combined influence of time and temperature on the changes of physical properties. The investigations of carbon steels have raised difficult problems in connexion with carbide spheroidisation as well as the obscure phenomenon of embrittlement shown by some of them. The results already obtained have been useful in determining suitable working stresses in advance of present practice. The general problems of the corrosion of metals and methods for their protection have been under continuous investigation. Experiments have been made on the corrosion of aluminium alloys when in contact with beverages and food stuffs. The importance of studying engineering noise problems is shown by the fact that the acoustics laboratory has been more than doubled in size. Using the methods of continuous evacuation developed in the Metropolitan-Vickers laboratories, rapid progress has been made in the technique required for the production of high vacua and its many applications to engineering problems. An X-ray set specially adapted for studying engineering problems has been developed and standardised and is now on the market. Progress has been made in inventing methods of protecting zinc and zinc base alloys by means of electro-deposited coatings. Special solutions have been discovered for cleaning, pickling and plating base metals of this kind. Accelerated corrosion tests have been devised which enable the protective value of different thicknesses of deposit to be rapidly determined.

Tariff of Electricity Supply

THE Central Electricity Board in conjunction with the National Consultative Technical Committee has prepared a form of tariff laying down the principles under which electricity will be supplied directly to authorised undertakings. This form of tariff applies to the whole of the supply given to undertakings which do not own 'selected' stations. It applies also to that part of the supply to selected stations which they do not generate for themselves. The new tariff consists of three parts. The first is a service charge in respect of each point of connexion to the grid, the second a fixed annual power charge based on the maximum demand for power during the year at each point of connexion, and lastly, a running charge for each kilowatt hour supplied. No service charge is made for the first point of supply. The kilowatt charge is based on the maximum demand for the year. This maximum demand is taken to be twice the largest number of kilowatt hours supplied during any half-hour in the months of January, February, November and December. This tariff has been agreed with the District Committee for mid-east England and the central Scotland tariff will be decided shortly. The tariff system, although at first sight complicated, is based on sound principles and should prove practical. Various modifications have to be applied when the energy supplied is less than the product of the volts and amperes, that is, when the power factor of the load is low. The application of the Act has necessitated the evolution of instruments which will measure both kilowatts and kilovolt amperes respectively. Accurate instruments of this type are now available. It will be interesting to see the magnitude of the reductions in price to the consumer in mid-east England.

Restoration of Prosperity to Transport

AT the present time the industry of transport seems to be far from flourishing. In the aggregate, statistics show that road, rail, air and water transport are losing money. We welcome therefore the paper by W. Rees Jeffreys, chairman of the Roads Improvement Association, on transport problems of the Empire, which was read to the Royal Society of Arts on November 29. He takes a world-wide view of the whole problem, pointing out some of the causes of the depression and making many helpful suggestions. All forms of transport are the servants of the community. They serve trade and industry, and so long as they are serviceable they are entitled to a fair remuneration. They are not entitled to place a burden upon trade or industry by excessive charges or by dictating to the producer and the manufacturer what kind of transport he shall employ. Anti-road transport legislation within the Empire for the purpose of protecting State investments in railways has failed to bring prosperity to the railways concerned. Railway finance has often failed because it proceeded on the assumption that railways are permanent and can always be made profit-earning by regulating rates. In Great Britain, road finance has proceeded on sounder lines, as highway expenditure has been met largely out of current expenditure. The ill-conceived legislation which has introduced rigidity into railway rates, wages, hours and conditions of labour has hindered progress to recovery. Co-operation between all kinds of transport is necessary, and rigidity is fatal to it. The closing down of non-paying railways and their conversion into roads should be encouraged. In the discussion, Mr. C. Erlund stated that an enormous saving could be effected so far as goods are concerned, by electrifying several of the main-line railways. This makes electrification a far more attractive proposition than it appears in the Weir Report.

A Modern Japanese Power Station

SINCE the inception of the Kyushu Hydro-Electric Railway Co. Ltd. about twenty years ago, the policy of using steam power in Japan as distinct from hydro-electric power has thoroughly justified itself. A description is given of their new 50,000 kilowatt steam generating station, in the *Metropolitan Vickers Gazette* for October. It was completed in September 1931 having taken little more than a year to construct. The total cost of this station is much lower for its output than any station previously built in Japan. The main buildings are heavy steel structures designed with a view of resisting earthquakes and the walls of the building are of corrugated sheet steel. The chief coal supply is transported by land, the power station being quite close to the main railway line. Special arrangements have been made to minimise the labour and time involved in handling coal. The flue gases are thoroughly cleansed before emission into the air. The larger particles of grit are caught in mechanical collectors and the fine dust and fumes are washed by high-pressure water sprays. The molten slag is tapped from the furnaces, broken into fine pieces by strong water jets, and removed by pump sluicing. The two steam turbine generating sets having outputs of 25,000 kw. at 11,000 volts were made by the Metropolitan-Vickers Electrical Co. Ltd. Electroflo steam instruments are used and Kent, Negretti, Siemens, Kelvin, Cambridge and Bailey boiler instruments have been installed. It is interesting to notice that power is transmitted to a substation at 22,000 volts by cables of the Emanueli oil-filled type, paper insulated with a double sheathing of lead.

Fur-bearing Animals in Michigan

REFERENCE to some results of Dr. Ned Dearborn's investigation into the food of predatory fur-bearing animals in Michigan has already been made in these columns (Dec. 17, 1932, p. 905). The pamphlet (52 pp.) in which the results appear, initiates, with the title of *Bulletin I*, a series of publications by the School of Forestry and Conservation in the University of Michigan, which will contain for the most part the results of studies by the Bureau of Forest Research. Conditions as regards the fur-bearing animals have changed much since the early days of colonisation, and although Michigan still ranks third amongst the States in fur production, the destruction of the forests—hard-woods and soft-woods in the north, nut-trees in the south—and the draining of the swamps, have vastly reduced the numbers of fur-bearers. It is said that the numbers are not half what they were twenty-five years ago; even the weasel (*Mustela noveboracensis*) is no longer common in many localities, and the only upland fur-bearer which has held its own is the skunk. It may seem strange that while in Britain we are engaged in a war of extermination against that new invader, the musk-rat, Dr. Dearborn should regret its disappearance with the draining of Michigan marshes for agricultural purposes. He says that in some cases marshes are now more profitable for the musk-rat fur they produce than they would be for agriculture if drained, and cites the case of a drained marsh near Athens in Calhoun County which to-day is said to be worth no more than a single crop of musk-rats would be were it still undrained. "As matters now stand," he writes, "it behoves the owners of marshes to consider well before attempting to drain them". Other conditions, other advice!

Preservation of Fossil Bones

THE difficulty of preserving fossil bones found in deposits of the later phases of the Ice Age or more recent beds is known to collectors and museum curators; often enough the bones crumble to dust after a night's exposure to the air. Much can be done by immediate attention to preserve such relics for examination and permanent exhibition, and a paper on the "Bakelite Impregnation of Fossil Bones" by H. W. Nichols and Phil C. Orr, of the Field Museum of Natural History in Chicago, ought to be widely known (*Museums J.*, vol. 32, p. 47, May 1932). In the Field Museum, most of the older impregnating materials have been tried, paraffin, glue, gum arabic, shellac, wolfite and several mastics. In some respects these are all deficient. Of the older materials, shellac was found to be the most satisfactory, but Dr. Case's bakelite process is better than any other. Broken bones are cemented with a mixture of plaster of Paris and dextrin, and when the cement is dry, the bone is placed on a screen and lowered gently into a tank of bakelite reduced to a suitable condition of fluidity by the addition of bakelite thinner. The bones thus treated are allowed to dry and the surface cleaned. The greater number of bones require no further treatment, but if a specially strong surface is required the bones may be baked at a temperature of about 208° F. or more, when the bakelite, undergoing polymerisation, gains full strength and becomes no longer soluble in the thinning solution.

Dr. Arnold Berliner

A SPECIAL issue of *Die Naturwissenschaften* for December 16 celebrates the seventieth birthday on December 26 of its founder and editor, Dr. Arnold Berliner. It extends to 73 pages, includes scientific contributions from more than forty authors and a frontispiece portrait of Dr. Berliner. Prof. Einstein in a short note recounts how twenty years ago Dr. Berliner saw that a periodical was wanted in Germany which would give accurate information on all branches of science and thus enable research workers in special fields to form their own opinions of advances in other fields. That his periodical has succeeded so well in this object is due to the catholicity of his interests and to his insistence that his contributors should express themselves in concise and clear language which could be understood by non-specialists. His fights to secure well written articles led him to say that a scientific author should be "a cross between a mimosa and a porcupine".

Spread of Influenza

According to Science Service, Washington, D.C., the influenza epidemic appeared to have reached its height in the United States at the end of December; for the week ended December 24, 123,138 cases were reported to the United States Public Health Service. In England and Wales a large increase in the number of deaths from influenza is shown in the Registrar-General's return for the week ended January 14, the figures being 1,041, compared with 681 the previous week. Greater London was the worst affected area, though considerable outbreaks are reported in many parts of the country.

Wensleydale Earthquake

Father J. P. Rowland, S.J., has given in the *Times* of January 21 his determination of the epicentre of the earthquake of January 14. The records at six observatories, from Stonyhurst (34 miles) to Oxford (187 miles), agree fairly well with a position half a mile to the north-east of Hawes Junction and a time at the origin of 8h. 30m. 20s., G.M.T. The shock was also observed at Felton in Northumberland, 70 miles from the above epicentre.

Cerebro-Spinal Meningitis

The period of the highest incidence of cerebro-spinal fever in Great Britain is approaching and it is clearly desirable to secure accurate observation on the efficiency and potency of all the serums in use. Since the most valuable test of the efficiency and potency of serums is clinical and it rarely happens that any one hospital has sufficient cases for useful differential study, the Ministry of Health is now endeavouring by means of individual case inquiry to collect and examine all evidence on serum treatment and the co-operation of medical officers of health, hospital medical officers and medical practitioners is invited. Forms for the purpose can be obtained on application to the Senior Medical Officer, Med. I., Ministry of Health, Whitehall, S.W.1.

Guide to the British Pharmacopœia

The British Drug Houses, Ltd., Graham Street, City Road, London, N.1, have issued a "B. D. H. Guide to the B. P. 1932", which will be of use to all who are interested in drugs, chemicals, galenical preparations, and the standards of the new British Pharmacopœia. The volume contains xvi + 122 pages, and, like the similar guide to the British Pharmacopœia of 1914 (of which a few copies are still available), is published at 2*s.* 6*d.* It is pointed out that the new "B. P." contains 128 articles and preparations which become official for the first time; while there are 357 deletions. Special attention is directed in the Guide to the former, and to innovations and alterations in general.

Announcements

Mr. Ll. B. Atkinson, a past president of the Institution of Electrical Engineers, has been elected an honorary member of the Institution.

The annual congress of the South-Eastern Union of Scientific Societies will be held at Norwich on June 7–10, under the presidency of Prof. E. J. Salisbury, Quain professor of botany at University College, London. Further particulars can be obtained from the secretary, Mr. Edward A. Martin, 14 High View Close, London, S.E.19.

The following have been elected officers of the Royal Microscopical Society for the present session: *President:* Mr. Conrad Beck; *Hon. Treasurer:* Mr. C. F. Hill; *Hon. Secretaries:* Mr. J. E. Barnard and Prof. R. T. Hewlett; *New Members of Council:* Dr. E. Hindle, Dr. J. E. McCartney, Mr. E. K. Maxwell, Mr. J. Rheinberg, and Mr. E. A. Robins.

The inquiry organised by the Inter-Parliamentary Union of Geneva and published in 1931 by P. S. King and Son, Ltd., at 16*s.*, under the title "What Would be the Character of a New War?" has been re-issued by Victor Gollancz, Ltd., at 5*s. net*. The original publication was reviewed at length in Nature of February 13, 1932 (p. 219).

Applications are invited for the following appointments, on or before the dates mentioned:—A member of the scientific staff of the Radio Research Station, Slough—The Secretary, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S.W.1 (Jan. 30). Assistant civil engineers for the Civil Engineer-in-Chief's Department, Admiralty and H.M. Naval Establishments—The Civil Engineer-in-Chief, Admiralty, London, S.W.1 (Feb. 18). A male assistant superintendent of traffic in the London Telephone Service and a male assistant traffic superintendent in the provinces, General Post Office—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (March 2). A technical assistant in the Directorate of Technical Development, Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. A research assistant in mycology in the Department of Agriculture, University of Cambridge—The Secretary, School of Agriculture, Cambridge.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A New Impulse Generator for Three Million Volts

OF recent years considerable attention has been focused on the behaviour of insulation under electrical stresses of very short duration. The importance of these studies need not be emphasised; suffice it to say that investigations in conjunction with the cathode ray oscillograph on all forms of insulating material at fairly low voltages and on all forms of assembled electrical high-tension apparatus at high voltages have still to be made, as the information at present available is of the most meagre nature.

These studies are very important, because every time an electrical circuit is made or broken a transient is propagated, and in addition, lightning is responsible for the occurrence of transients of large magnitude in exposed circuits, such as overhead transmission lines. In the laboratory, low voltage transients are easily produced, but the apparatus required for the generation of high voltage transients has hitherto been very bulky on account of the large clearances which are necessary between all the active parts of the generator. To extend the scope of our investigations with higher voltage transients would necessitate buildings of enormous dimensions, and the object of this note is to indicate how such requirements can be obviated.

The circuit most commonly used for the generation of transients comprises essentially a condenser and a spark gap. For high-voltage impulses, it is not economical to construct a condenser to withstand the full required impulse voltage between the poles, and recourse is therefore made to a number of lower-voltage condensers connected in series. These may be charged in parallel with a voltage V and discharged in series, a voltage nV being thus generated, where n is the number of condensers. The switching over from parallel to series connexion is performed by spark gaps. When suitably constructed, these spark gaps are known to break down in times of the order of 10^{-7} sec., so that a generator having many condenser and spark gap stages can still produce a transient of very steep wave front.

An obvious method of reducing the size of the generator is to immerse the whole of the apparatus in a medium of higher electric strength than air, for example, in oil. Unfortunately, the time lag of breakdown of the spark gap is thereby considerably increased, and the rate of rise of voltage of a multi-stage impulse generator is therefore very seriously diminished. Furthermore, the gas bubbles and carbon liberated in the spark gaps are undesirable features, and the energy absorbed in the gaps greatly reduces the efficiency of the generator. By the removal of the spark gaps from the oil chamber containing the condensers, most of the economy in dimensions gained by the use of the oil container is sacrificed, and difficult bushing problems are introduced.

It has been found that in air the time lag of a sphere spark gap decreases with increasing air pressure, while it is well known that for small spacings the air pressure/breakdown voltage curve of the sphere spark gap is approximately linear. Here we have the exact requirements for a compact, oil-immersed impulse generator capable of producing transients of steep wave front. If all the spark gaps are segregated into a column of air at high pressure, the compact features of the oil-immersed generator are preserved together with the advantageous electrical features of spark gaps operating in a gaseous instead of a liquid medium. On these principles, we have constructed an impulse generator capable of delivering 3 million volts in an oil container 5 ft. in diameter and only 10 ft. in height. The condensers are of the oil impregnated type and are all charged in parallel through resistance columns arranged vertically in the cylindrical container. Connexions from each condenser are taken to the spark gaps, arranged also in a vertical column in a tube immersed in the same oil chamber and under a pressure of many atmospheres of air. Only the low voltage connexions to the condensers and the lead carrying the full impulse voltage appear outside the oil container, as even the potential divider for connexion to the cathode ray oscillograph is incorporated in the same oil tank, and is therefore of very small linear dimensions.

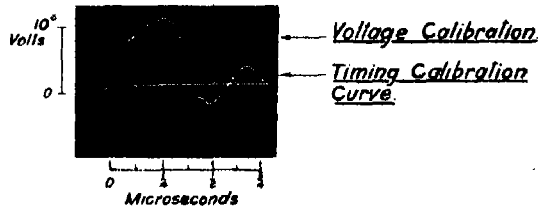

FIG. 1.

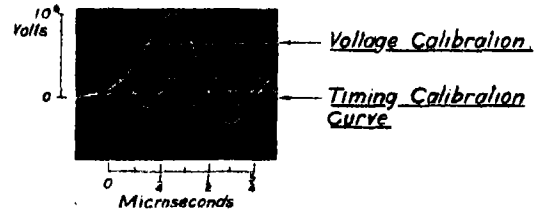

FIG. 2.

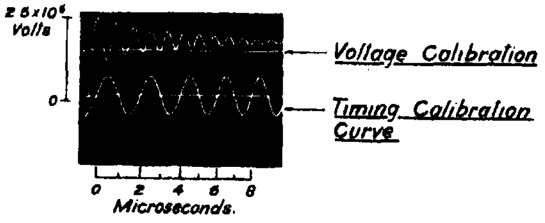

FIG. 3.

Figs. 1 and 2 illustrate the effect of air pressure on the steepness of the wave front of the transient, the rate of rise at atmospheric pressure (Fig. 1) being 3000 kv./μ sec., while at a pressure of 3 atmospheres (Fig. 2) this has increased to 4800 kv./μ sec.

The transient was applied to a sphere gap set for about 1000 kv. and the oscillograms show the very short time lag before breakdown of the gap.

Fig. 3 shows the open circuit wave of the generator operating at approximately 2500 kv. The rate of rise of voltage is 6000 kv./μ sec., and a time of 200 μ sec. elapses before the voltage has fallen to half its maximum value. The oscillations can of course be removed by the introduction of an appropriate resistance into the circuit.

Our thanks are due to Mr. H. C. Thompson for help in the construction of the apparatus, to Messrs. W. G. Hawley and R. V. Whelpton for their assistance with the cathode ray oscillograph, and to Mr. A. P. M. Fleming for permission to publish this note.

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F. S. EDWARDS.
D. B. MCKENZIE.

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Research Department,
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Trafford Park, Manchester.
Dec. 12.

Energy of Cosmic Rays

IN NATURE for September 3, 1932, p. 364, I published the curve of the intensity of cosmic radiation in the high atmosphere, deduced from measurements made with a self-registering electrometer. It was possible by extrapolation to find the intensity I_∞ of radiation at its entrance in the atmosphere. The preliminary value given has now been corrected by the experimental determination of the factor which reduces the measurements with the ionisation chamber at 5 atmospheres to 1 atmosphere. Now the value I_∞ is found corresponding to a production of 333 pairs of ions cm.$^{-3}$ sec.$^{-1}$ in air at 0° and 760 mm. mercury pressure.

The graphical integration of the curve, giving the ionisation as a function of the height, makes it possible to calculate the total number of ions, produced by total absorption of cosmic rays by a column of air of 1 sq. cm. section. The high value of $1{\cdot}02 \times 10^8$ pairs of ions is found. Some time ago, Millikan and Cameron[1] made a similar calculation, which gave a value of only $1{\cdot}28 \times 10^7$ pairs of ions, due to an insufficient knowledge of the intensity in the high atmosphere. Taking the energy required to produce a pair of ions in air[2] as 32 electron-volts the flux S of energy coming to the earth from the cosmic rays is found to be $5{\cdot}2 \times 10^{-3}$ erg. cm.$^{-2}$ sec.$^{-1}$.

From an astrophysical point of view, the great energy of cosmic rays is remarkable. A body which absorbs all the cosmic rays would be heated by them. Equilibrium will be attained when the absorbed flux S of cosmic rays is equal to the heat radiation σT^4 of that body. T works out as 3·1° Kelvin. The value is equal to the temperature (3·18°) which Eddington[3] finds for a black body heated only by the heat and light radiation of stars. Eddington's calculation relates to a point in our local system of stars, but not in the neighbourhood of one of them. If at such a point the flux of energy of cosmic radiation is equal to that on the earth, the temperature of a black body, absorbing entirely the *two* radiations, rises only to 3·7° Kelvin, according to the T^4 law. But at a point in space among the spiral nebulæ, the ordinary radiation is very small and causes only a very small rise of temperature. Supposing that cosmic rays originate in such intergalactic space, they would produce an elevation of temperature corresponding to the flux of cosmic rays.

A more detailed report will be published shortly in the *Zeitschrift für Physik.*

E. REGENER.

Physik. Inst. d. Techn. Hochschule,
Stuttgart.
Dec. 31.

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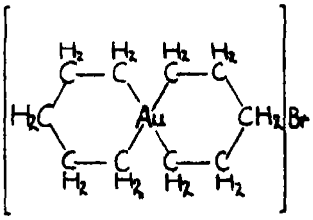
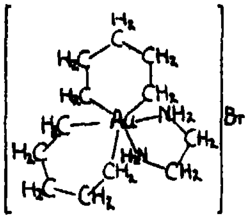
[1] *Phys. Rev.*, 31, 930; 1928.
[2] H. Kulenkampff, *Phys. Z.*, 30, 777: 1929.
[3] "Internal Constitution of the Stars", German edition, p. 466, 1928.

Organic Compounds of Gold

THE reaction between hydrobromoauric acid and magnesium pentamethylene bromide in ethereal solution proceeds somewhat differently than with the simpler magnesium alkyl bromides[1]. A colourless, crystalline, sparingly soluble salt is obtained which must be *spiro*bis(pentamethylene)gold bromide (i).



(i)



(ii)

This compound has been identified through its ethylenediamine derivative, ethylenediamino*spiro*bis-(pentamethylene)gold bromide (ii), which is a fairly stable colourless crystalline salt having a greater solubility in water than compound (i).

These compounds present several points of interest. In (i), the gold atom, as in many gold compounds, is 4-covalent with an octet of electrons and it is significant that a gold atom attached to four carbon atoms can function as a cation. In (ii) the gold atom is 6-covalent, and while gold compounds have been described in which the gold atom is 6-covalent, they are very few. Further, since the groups attached to the gold atom must have an octahedral configuration, compound (ii) should be capable of being resolved into optically active isomers. This is the first compound to be described in which a configuration of groups attached to a gold atom permits of this possibility.

The investigation indicated is being continued and extended in various directions. The small amounts of these organic gold compounds obtained at present in any one reaction which takes at least two weeks is only one of the factors which explain the slow progress of the work.

Chemistry Department, C. S. GIBSON.
Guy's Hospital Medical School,
London, S.E.1.
Dec. 31.

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[1] Pope and Gibson, *J. Chem. Soc.*, 2061; 1907. Gibson and Simonsen, *ibid.*, 2531; 1930. Gibson and Colles, *ibid.*, 2407; 1931. Gibson, "Chemistry at the Centenary (1931) Meeting of the British Association", p. 260.

Iodoacetic Acid, Glutathione and Tissue Glyoxalase

DUDLEY[1] has shown that the action of tissue extracts in converting methyl glyoxal to lactic acid, or phenyl glyoxal to mandelic acid, is inhibited by iodoacetic acid. Lohmann[2] considers, however, that this is probably not the cause of the poisoning action of iodoacetate on animal tissues, since, in the case of the crude extracts used, a much higher concentration of iodoacetate was needed than that required to stop glycolysis.

Quite recently Lohmann[3] has made the important discovery that reduced glutathione can function as a co-enzyme to methyl glyoxalase deprived of its activity by dialysis. Working either with such extracts of rat liver purified by isoelectric precipitation of much of the protein and by dialysis, or with undialysed extracts, I find that the action of iodoacetic acid in arresting glyoxalase activity is completely reversed by the addition of reduced glutathione to the inhibited extract. The reaction occurs at once even in the presence of a ten-fold excess of the inhibitant, and clearly shows that the action of iodoacetate does not involve irreversible destruction of the enzyme itself. Further, in a dialysed extract activated by a known amount of glutathione, the quantity of iodoacetate required to stop lactic acid formation is approximately equivalent to the glutathione added to that extract. Thus the powerful activity of the purified extract, conditioned by the presence of added glutathione in 10^{-4} to 3×10^{-5} molar concentration, is rapidly retarded or inhibited by iodoacetic acid in the same molecular concentration.

On the other hand, the glyoxalase activity of the crude extract is quite unaffected by this concentration of iodoacetate; it must be increased about a hundredfold in order to arrest or retard the lactic acid formation. The behaviour of fresh liver slices, studied by Warburg's method, I find much more nearly corresponds with that of the purified extracts; with concentrations of iodoacetate down to $1 \cdot 5 – 5 \times 10^{-4}$ molar, the inhibition of glyoxalase action is well marked, and here also the activity is immediately restored by the addition of reduced glutathione (10^{-3} molar) to the contents of the vessels.

These results suggest the occurrence of a direct interaction between glutathione and iodoacetic acid; and this has in fact been observed. If dilute neutral solutions of iodoacetic acid and purified glutathione are mixed, a vigorous reaction occurs in which acid (HI) is liberated and the sulphydryl group of the glutathione is attacked. The progress of the reaction is followed by mixing the bicarbonate solutions of the two reactants in an atmosphere of nitrogen and carbon dioxide (*p*H of solution 7·4) and measuring manometrically the carbon dioxide evolution due to acid production. It is then found that for each molecule of reactant decomposed one equivalent of acid is set free; the kinetics and chemistry of this reaction are now being further investigated.

How far the other actions of iodoacetate may be referred to a similar mechanism, or to oxidative reactions in the way suggested by Waldschmidt-Leitz and Schäffner[4] and by Bersin[5] is not yet clear.

FRANK DICKENS.

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London, W.1.
Jan. 14.

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[1] *Biochem. J.*, **25**, 439; 1931.
[2] *Biochem. Z.*, **236**, 444; 1931.
[3] *Biochem. Z.*, **254**, 332; 1932.
[4] *Naturwiss.*, **20**, 122; 1932.
[5] *Biochem. Z.*, **248**, 3; 1932.

Structural Formulæ of the Chlorophylls

SOMEWHAT more than a year ago, a structural formula for chlorophyll-*a* was suggested[1] in which a carbomethoxy residue was placed in the β-position of one pyrrole ring. This seemed necessary as a monomethyl ester (phæopurpurin 7) was obtained as one of the products of an oxidative hydrolysis ('phase test') and the position of the methoxyl group in this phæopurpurin was clearly established. We have now found that the purest samples of the phæophorbides of the 'a' series do not yield any phæopurpurin 7. Under special conditions of oxidative hydrolysis, a monomethyl compound can be isolated (as the sole product) and the carbomethoxy group in this substance can be shown to be part of the side chain attached to the bridge (the so-called γ-position). This finding is in accord with the position of the methoxyl group in Fischer's formula for chlorophyll-*a*.

We have found in the mother liquors from the purification of the phæophorbides, considerable quantities of a material very similar to the normal members of the 'a' series but which on oxidative hydrolysis yields phæopurpurin 7 (a monomethyl ester). The presence of this material in our original samples was thus responsible for the phæopurpurin 7 which we obtained. It is difficult to separate this substance from phæophorbide-*a*, which it appears to resemble closely in physical and chemical properties. There seems no escape from the conclusion that we are dealing with a substance very similar to phæophorbide-*a*, but differing in the position of the methoxyl group. The oxidative hydrolysis of crude chlorophyll or of chlorophyllides has shown that a precursor of phæopurpurin 7 is present to the extent of 1–5 per cent in a variety of plants. The mother liquors from crystalline ethyl chlorophyllides from *Datura* contain as much as 20 per cent. It would appear that there are two forms of chlorophyll-*a*, and we are now engaged in an attempt to isolate in a pure state the second form (or the corresponding chlorophyllide). There are some indications that a similar situation exists in regard to chlorophyll-*b*, but there has been no definite evidence as yet published establishing the position of the methoxyl group in the 'b' series.

If there are two very similar forms of chlorophyll-*a*, differing only in the position of a methoxyl group, a formula must be found which allows of the interchange of the methoxyl group between two potential carboxyl groups without serious structural modification. This interchange must involve the carboxyl group of the pyrrole ring and that of the bridge. The lactam formula, which we mentioned previously[2] as an alternative of our anhydride formula, satisfies these requirements; the anhydride formula does not, nor do the formulæ containing a carbocyclic ring connecting the pyrrole nucleus and the bridge.

The analyses of the pure phæophorbides present a difficulty as we have realised for many months, and has recently been emphasised by Stoll[3] and Fischer[4]. We are strongly inclined to the opinion that on isolating and drying the crystalline compounds, water is lost, leaving an unsaturated grouping which then adds water again in solution, regenerating the hydroxy compound.

A more detailed discussion of the structural formulæ of chlorophyll-*a* and -*b* will be given in a series of papers to be published shortly.

JAMES B. CONANT.
EMMA M. DIETZ.

Converse Memorial Laboratory,
Harvard University,
Cambridge, Mass.
Dec. 8.

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[1] *J. Amer. Chem. Soc.*, **53**, 2382; 1931.
[2] *Ibid.*, **53**, 2384; 1931.
[3] *Ann.*, **499**, 84; 1932.
[4] *Helv. Chim. Acta*, **15**, 1128; 1932.

'Raw' Weather

I EXPECT that Sir Leonard Hill's remarks in NATURE of January 7 (p. 28) on this subject go a long way towards answering the inquiry about the physiological effects of raw weather, but I doubt if they cover the case of deep-seated pain to bedridden rheumatic people. Yet such people are sometimes very sensitive to climatic conditions, so sensitive indeed that some of them will predict a change in weather unfailingly. They will tell you they can feel it in their bones and it may be, with people so situated, that actual changes in humidity or temperature can scarcely be invoked as causative factors, that they are directly susceptible to barometric fluctuations.

The suggestion might be checked if a group were willing to allow the experimentalist to subject them to slight variations in pressure.

Barnato Joel Laboratories, **SIDNEY RUSS.**
Middlesex Hospital.
Jan. 7.

IN his letter dealing with 'raw' weather, Dr. Dobson[1] has raised a question of considerable human interest which will probably require the combined experience of physicists and physiologists for its solution.

One explanation has already been mooted by Sir Leonard Hill[2], but apparently rests on the misapprehension that: "Cold moist air has a much higher conductivity than cold dry air." Reference to the "International Critical Tables" shows that, so far as information relating to the thermal conductivity of water vapour is available, this is not likely to be the case. At 46° C. the conductivity of water vapour is 12 per cent less than that of dry air, and there is no apparent reason why it should be greater at lower temperatures. It is difficult to imagine, therefore, how the admixture of a comparatively small proportion of water vapour with air could result in an *increased* thermal conductivity of the mixture.

Although the explanation of 'rawness' based upon the effect of moisture in the atmosphere appears to be untenable, it may be that the moisture content of clothing is important. There is evidence that even a small quantity of water adsorbed on the fibres of a textile material causes a considerable reduction in its insulating efficiency. Cold weather in England—at any rate in the south-eastern part of it—is usually dry enough to allow free transpiration of water vapour through the clothing. In 'raw' weather, however, the water excreted by the skin is retained in the clothing, with consequent feelings of chill and discomfort.

Another physical condition which may prove significant is the ionic content of the atmosphere. Work now proceeding on the Continent and in the United States[3, 4, 5] indicates that this factor, which is very variable, can produce remarkable physiological effects. In a cold environment the feeling of 'rawness' may well be one of them.

Building Research Station, **H. E. BECKETT.**
Garston, Herts.
Jan. 17.

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[1] NATURE, 131, 28, Jan. 7, 1933.

[2] *Ibid.*

[3] *Acta Rheumatolog.*, 4, 12; 1932.

[4] *Heating, Piping and Air Conditioning*, 3, 865; 1931.

[5] *Aerologist*, 8, 26; 1932.

Molecular Fluorescence of Antimony

WE have obtained a rather strong fluorescence of diatomic vapour of antimony illuminated by a mercury arc of high luminosity; the temperature was about 950° C. and the pressure corresponded to a temperature of about 650° C.

There are four mercury lines which certainly excite a resonance spectrum and two other probable ones; the results are given in the accompanying table.

	Exciting Hg lines	No. of negative terms.	No. of positive terms
Certain	2967 A.	1	18
	3022	2	11
	3126	2	6
	3132	4	7
Probable	2925·5	1	1
	3342	1	5

The frequencies of the resonance terms can be accounted for by the equation

$$\nu = \nu_0 - 277\,(v'' + \tfrac{1}{2}) + 0{\cdot}68\,(v'' + \tfrac{1}{2})^2$$

Details of the investigation will be published shortly in *Bull. Soc. Roy. Sci.*, Liège, Belgium.

JEAN GENARD.

Department of Astrophysics,
University, Liège.

Absorption of Light in Cæsium Vapour

WE have measured the absorption of light in cæsium vapour, by photographic photometry, from the series limit (λ 3184 A.) to λ 1935 A. The absorption cell was a quartz tube two metres in length. The vapour was superheated to about 270° C. and the vapour pressure was varied from 0·15 mm. to 0·6 mm.

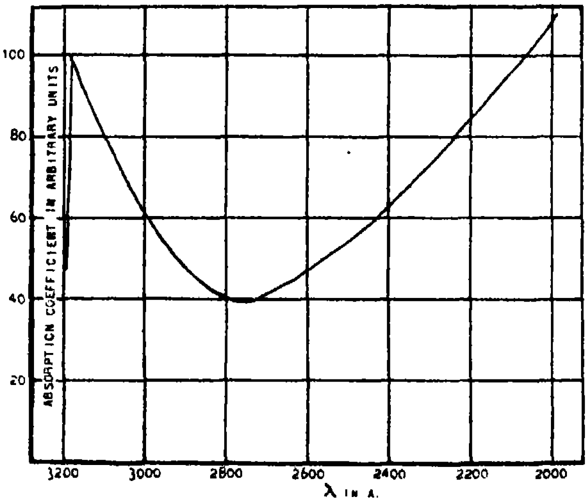

FIG. 1.

The absorption at any one wave-length appears to be directly proportional to the pressure, and the variation with wave-length is shown in Fig. 1.

The results may be compared with those obtained for the photo-ionisation of cæsium vapour[1, 2, 3, 4]. Mohler and Boeckner[1] made absolute measurements of the photo-ionisation for λ 3130 A. and obtained a value corresponding to an atomic absorption coefficient of 1·85 × 10^{-19} cm.$^{-1}$. Our experiments give, as a preliminary value[5] for the total absorption at the same wave-length 1·92 (± 0·1) × 10^{-19} cm.$^{-1}$. These agree within the limits of error and indicate that the whole absorption at this wave-length is photo-electric.

The form of the curve agrees more closely with the curve obtained by Little[3] and by Cooke[4] than with that obtained by the other workers[1, 2]. The rise in the absorption in the far ultra-violet is interesting and difficult to explain. We made special experiments which verified that this absorption is proportional to the vapour pressure. It therefore appears to be an atomic phenomenon.

We hope to complete the experiments and to publish a full account shortly.

H. J. J. Braddick.
R. W. Ditchburn.

Trinity College,
Dublin.
Dec. 19.

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[1] Mohler and Boeckner, Research Paper No. 96, U.S.A. Bureau of Standards.

[2] Little, *Phys. Rev.*, **30**, 109; 1927.

[3] Lawrence and Edelfsen, *Phys. Rev.*, **34**, 233; 1929.

[4] Cooke, *Phys. Rev.*, **38**, 1351; 1931.

[5] This value is based on a cæsium vapour pressure derived from the formula given by Mohler and Boeckner (loc. cit., p. 807)

Reversal of the Current from a Cuprous Oxide Photo Cell in Red Light

WHILE testing the sensitivity of photo cells of the rectifier type for various wave-lengths, we have observed a small reverse current with a cell of the 'Serpidox' make exposed to red light. As we have seen no reference to this effect, a few details may be worth noting. The cell is a commercial form of that described by M. Auger, the cuprous oxide film being covered with a thin conducting film, which we believe to be of gold. Contact is made with the latter by a metal ring, the inner edge of which forms the rim of the pupil, 17 mm. in diameter.

The inverse effect is irregularly distributed over the cell, as was shown by successively illuminating various areas, each about 4 mm. in diameter, with a beam of light of wave-lengths between 6070 A. and 6270 A. For a region some 5–6 mm. square, not quite central in the pupil, the current obtained was in the same direction as that for green, blue, or white light. For all other parts of the disc a varying negative response was obtained. Illumination of the metal rim is not necessary for the inverse effect, a relatively large negative response being obtained from a region near the centre. On the average, however, the central part of this cell gives a positive, and the marginal a negative response, the net effect of the whole cell being negative for this light.

The following figures indicate the behaviour of the cell for yellow and red light, λ being the mean wave-length of the light, and S_1 and S_2 the sensitivities of the central and marginal regions, respectively, expressed as percentages of the maximum sensitivities, which, in each case, occurred near 5,000 A.

λ (in A.)	5840	5940	6060	6170	6280	6380	6480
S_1 (per cent)	51·1	36·4	23·2	7·5	2·8	0·1	0·05
S_2 (per cent)	58·4	39·4	16·7	−5·0	−10·6	−7·1	−1·9

For longer wave-lengths to the end of the visible spectrum, S_1 was zero and S_2 had small negative values.

A cell made, and kindly presented to us, by M. Auger showed the inverse effect to a very slight extent. A second 'Serpidox' cell mounted in one of our marine photometers gave a reverse current when covered with a Schott und Gen. *R.G.*1 or *R.G.5*, or a Wratten No. 88 red filter and exposed to daylight in the laboratory. No reverse effect could be detected with a Siemens cell, which had a relative sensitivity about + 1·4 per cent at 6380 A. In this cell the conducting film is of silver.

As the current flowing in the external circuit of any of the above cells under the influence of white light is from the copper back to the transparent film, it would seem probable that it is due to a front surface effect of the cuprous oxide film, the back surface being screened by the opacity of the film. If we assume that red light penetrates the thinner parts of the oxide film in the Serpidox and Auger cells to such an extent as to cause the back surface effect to preponderate, we obtain at once an explanation of the patchy nature of the red reversal.

As an alternative explanation, we might attribute the reversal to the presence of cupric oxide, which Athanasiu has shown to give a reverse E.M.F.[1] As the cupric oxide, unlike the cuprous, is sensitive to wave-lengths greater than 6500 A., he obtained a reversal with a mixed oxide photo-voltaic cell in red light.

The possibility of such an effect occurring in these cells is obviously of importance if they are used to compare illuminations of different colours.

H. H. Poole.

Royal Dublin Society, Dublin.

W. R. G. Atkins.

Marine Biological Laboratory,
Plymouth.
Dec. 28.

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[1] *C.R. Acad. Sci.*, **195**, 767; 1932.

Twisted Trees

To one who has long been working on the problems presented by twisting (spiral grain) in trees, the suggestion made by Dr. Copisarow[1] that the phenomenon may be traced back to the mineral constituents of the cells, comes as a further possibility calling for examination in light of the facts so far as they have been recorded. Knorr's article in the *Journal of Heredity*, which was noticed by NATURE in the issue of July 23 (p. 136), 1932, and called forth the suggestion now under consideration, was apparently written without reference to the existing literature, even American literature, and leaves the reader with the impression that a new field was being examined for the first time, whereas it has attracted attention for at least a century.

Dr. Copisarow uses Knorr's data showing right- and left-handed twist to be approximately equally frequent as an argument in support of his suggestion, whereas the typical mode of occurrence is for either right- or left-handed twist to predominate strongly according to the species concerned. In certain species of pines in Europe and India, almost a hundred per cent of the trees over extensive areas may exhibit definite left-handed twist without a single example of right-handed twist. A change over in the individual from left-handed in youth to right-handed later in life is a fairly common phenomenon, recorded, for example, by McCarthy in America for *Picea rubra*. The mode of occurrence of twist often suggests that the soil may be the cause, but, at least in *Pinus longifolia*, twist may be equally prevalent on limestone with a deep clay loam soil, as on mica schist with sandy loam or on coarse granitic gneiss. Knorr's observation is significant that of several species, all liable to twist, perhaps only one would be found to be twisted in a given area, and another in a second area.

Twist in trees certainly appears to originate during the secondary growth of the stems and there are indications that the so-called sliding growth of the tracheids in conifers may be intimately connected with the development of an increasingly inclined slant to the grain of the wood. Further knowledge on the growth of wood elements from the cambial initials is required to enable us to understand exactly what happens, knowledge to which Prof. Priestley's studies in Leeds are making important contributions.

Unless Dr. Copisarow can develop his suggestion so that it will account for twist predominantly in one direction or another irrespective of soil, and for a change over in direction with time, it does not take us much further than my own made in 1925, that such a detail as the prevalent direction of circulation of the cell contents (if they do circulate at all) might decide the initial direction, and sliding growth might accumulate small inclinations (if the tracheids do slide or anything like it).

H. G. CHAMPION.

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Dec. 1.

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[1] NATURE, 130, 541, Oct. 8, 1932.

Spectrum of γ Cassiopeiæ

SINCE photography was first applied for recording the spectrum of this bright star, its spectrum has always been considered to be of a constant character. In 1928, I announced that a slight change had taken place, and since then I have made numerous observations which completely corroborate its variability. The relative intensities of the bright components of the hydrogen lines in the latter half of 1931 were such that the red components were a little brighter than the violet components. Since then, the violet components have been steadily increasing in intensity, and now (January) they are very much stronger than the red components, so much so that, in the case of $H\epsilon$ and $H\zeta$, the red components are scarcely visible while the violet components are quite strong.

A detailed discussion of all my observations since 1921, which include more than sixty photographs, will be published at a later date.

WILLIAM J. S. LOCKYER.

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Sidmouth.
Jan. 15.

Heterogony and the Chemical Ground-Plan of Animal Growth

IN his letter in NATURE of December 3, Dr. J. Needham suggested that "the chemical ground-plan [of development] must be thought of as deformable in space-time". In this connexion, the deformations which are obtained by a change in the unit of time measurement seem to be particularly interesting. Needham showed that if we have two animals a and b and measure in each of them several chemical magnitudes M_a, M_b, N_a, N_b, etc., such as fat content, dry weight, etc., we find relations of the type $\log M_a/M_{a_0} = k \log N_a$ and $\log M_b/M_{b_0} = k \log N_b$ where M_{a_0}, M_{b_0} are specific constants and k is a general constant relating M and N for all animals. Now M and N are also functions of the time t. If we have $\log M_a/M_{a_0} = F(t)$ and $\log M_b/M_{b_0} = F(t)$ we can clearly choose another variable p such that $F(p) = f(t)$. That is to say, by choosing a suitable unit for the measurement of time, we can convert the growth curve of M_b into that of M_a: and further, the same system of time measurement will convert all the growth curves of chemical magnitudes of animal b into those of animal a, provided only that in each case there is the linear relation between the logarithms, with the general constant k which Needham discovered. Thus we could regard the two systems of time measurement defined by t and p as the relative time scales of chemical development of the two animals.

Such relative time scales may become very interesting when data are available for comparing them with relative developmental time scales derived in other ways. The relative time scales of morphological development can be obtained fairly easily. Now it has been shown in various cases that the morphological stage at which an organ becomes embryologically determined may vary widely in nearly related species. These two criteria, namely, stages of morphological development and times of determination of different organs, should provide two other systems of relative time measurements. It would be very interesting to know how these two are related to one another and to the time scales of chemical development.

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Jan. 2.

The Constant of Gravitation, *G*.

IT appears that before the advent of the theory of relativity the constant of gravitation was purely empirical. No theoretical estimate or discussion of it has at any rate come to my notice. It is perhaps worth while to obtain a theoretical explanation of the constant, even from the point of view of Newtonian gravitation, in view of the remarkable success of the latter in the regions of space that have already been explored. Following Mach, one expects that the constant G should be dependent upon the distribution of matter in the entire universe: it may be explained in terms of the other universal constants of relativistic cosmology.

Suppose that the total matter in the universe is distributed at random in a sphere of radius R where the boundary condition is furnished by corpuscular radiation going round with the velocity C. Then, according to Newton,

$$MG/R^2 = C^2/R \text{ or } MG/C^2 = R,$$

where M is the total mass in the universe. We may compare with this the relativistic formula

$$M^+ G/C^2 = (\pi/4)R \text{ for the Einstein world.}$$

There are two reasons why M and M^+ should differ slightly as they do; first, in estimating M^+ the entire mass is supposed to be at rest, which is far from the truth, and secondly, there is the mathematical difficulty of measurement pointed out by Painlevé[1].

V. V. NARLIKAR.

Hindu University,
Benares.
Dec. 7.

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[1] *C. R. Acad. Sci.*, 173, 878.

Research Items

Excavations at Kuala Selinsing, Perak. Mr. Ivor H. N. Evans, having carried out further excavations on the Tanjong Rawa site, Kuala Selinsing, Perak, Malay Peninsula, has now summarised his conclusions in an account of this later work (*J. Fed. Malay States Museums*, vol. 15, pt. 3). The inhabitants were not Mohammedans, and were traders in beads of semi-precious stones and glass. Some of these were of local manufacture. The stone beads probably came from India; others show affinities with Borneo and Sarawak, and with ancient beads found among Kachins and Chins, these in the latter instance being derived ultimately from both China and India, sources with which the Selinsing people may have been in touch. A piece of yellow lead slag may point to a connexion with the southern Shan States. The beads from Kuala Selinsing belong to a late iron age to early porcelain age culture that existed in India, the Malay Peninsula, Borneo and the Philippines. The people were almost certainly Hindus, as a definitely Hindu type of gold object has been found in the lower layer of the excavations; while a cornelian seal with a Pallava inscription (one of the most remarkable objects found in Malayan excavations in recent years) points to a connexion with southern India. The village would appear to have been built originally over the water, but accumulations of household refuse produced an island above the level of the highest tides. Burials took place under or among the houses, the bodies being placed in canoes and broken porcelain strewn over them. There are many types of pottery, mostly wheel-made with patterns akin to ancient Korean and Chinese. The settlement appears to have come to a violent end soon after A.D. 960, a date indicated by the presence of celadon wares. The earliest date suggested for the seal is about A.D. 400, but it was not found in the lowest level and may have been treasured for hundreds of years after the date of its manufacture, or perhaps be a survival of a script obsolete in India.

Shamans and Spiritism on the Mosquito Coast, Honduras. In an ethnographical survey of the Miskito and Sumu Indians of Honduras and Nicaragua (Bull. 106, Bureau of American Ethnology), Dr. Eduard Conzemius describes religious manifestations which have appeared among these peoples within the last forty years. These Indians are inhabitants of the tract of land once familiar under the name of the Mosquito Coast. The Miskito, who number about 15,000, are largely mixed with negro blood, as they intermarry freely with foreigners and assimilate all races readily. The Sumu, on the other hand, are exclusive. They number about 3,000 only and are decreasing. Many of the tribes, of which the names are preserved, have died out. Their language has many variants, some of which are mutually unintelligible. The shamans play a great part in the lives of these peoples, acting as medicine-men, doctors, augurs, rain-makers, conjurors, wizards, and the like. Their opinions carry great weight in tribal assemblies. According to tradition, their art was introduced from the east by a white man. The Sumu have only one class of medicine man, the sukya, whose office is hereditary. Nearly every village has its sukya. Among the Miskito, however, there is also a higher type, the okuli; but of these there should not be more than one at a time. He is a special representative of the Thunder God, and controls the elements. The new movement in religious manifestations is not unlike the nyalism of the Jamaican negro. It is a form of possession which seizes on the people when they are engaged in earnest prayer. They claim that they then have no control over their movements, which are due to the presence of the Holy Ghost. They are believed to be able to cure the sick by the laying on of hands, and to have revelations from God during their dreams. Obeah, brought from Africa by slaves, still exists.

Spread of the Great Crested Grebe in Britain. A very thorough collection of information relating to the great crested grebe in Britain has been made by T. H. Harrisson and P. A. D. Hollom with the help of 1,300 collaborators, and this together with the analysis of the data makes a most important account of the history of the species (*British Birds*, Aug. to Nov., 1932). In 1860, following a period of slaughter for the sake of the feathers, only about 42 pairs were left in England; but a continuous and progressively rapid increase has raised the number in 1931 to about 1,154–1,161 breeding pairs and a total population of some 2,650 adults. The spread has in general been from east to west, and there can be no doubt that the Wild Birds Protection Acts of 1880 and earlier have been a main factor in the increase, although the fact that increases have also occurred on the Continent points to a widespread influence. There too, however, increasing protection by law has to be reckoned with. In spite of protection, human interference is still the main cause of recorded deaths (36 per cent). The authors have estimated that a pair of grebes and their young consume 300–630 lb. of fish in the course of a summer; which gives a total fish consumption from England and Wales of 900,000 lb. a year. A careful analysis is made of mortality factors, and it is pointed out that the habits of covering the eggs when the nest is left and of carrying the chicks upon the back have been important acquisitions in reducing mortality from the attacks of egg-eating birds and of pike.

New British Copepod. Mr. D. J. Scourfield has discovered at Tenby a new species of *Cyclops* which he describes in a paper entitled "A New Species of *Cyclops* found on the Cliff-face at Tenby (*Cyclops* (*Bryocyclops*) *demetiensis*, sp.n.)" (*Ann. and Mag. Nat. Hist.*, ser. 10, vol. 10, p. 559, December 1932). It is an event of importance when British copepods new to science are found because this group is one of the best known. The present species was found, at first one specimen only, in some wet greenish earthy material from a spot on the cliff-face of the North Bay at Tenby, Pembrokeshire, where a minute trickle of water came oozing out of a small fissure in the rocks. Later on, further specimens were found in the same place but where there was a slight admixture of moss. Only this one restricted locality yielded the copepods. This find is specially interesting because all other known *Bryocyclops* are tropical, coming from Java and the New Hebrides, living in wet moss, cups formed by the leaves of plants or in empty coconut shells. Mr. Scourfield is of the opinion that his new species is not truly a moss-dweller but rather that its true habitat is in the fissures in the rocks. *Cyclops* (*Bryocyclops*) *demetiensis* is a pretty little copepod with a peculiar eye of very unusual form surrounded by a mass of black granules in three parts, one dorsal and two lateral. It is possible that the form of the eye may have something to do with its mode of life in dark places. It is an active swimmer. Although no ovisacs were seen, a few nauplii were discovered in the bottle containing the copepods. These nauplii showed a separation of the eye parts which is very characteristic.

Mites of Fruit Trees. Literature dealing with the mites attacking fruit trees is not very accessible to the general horticulturalist, so that a lengthy synopsis by Mr. A. M. Massee is very acceptable (*J. Pomol. and Hort. Sci.*, vol. 10, No. 2, 1932, pp. 106–129, "Some Injurious and Beneficial Mites on Top and Soft Fruits".) The mites are dealt with according to the trees they attack, and apples, pears, plums and damsons, cherries, peaches, nectarines and apricots, nuts, walnuts, quinces, currants, gooseberries, raspberries, blackberries and strawberries are mentioned. It is interesting to note that there are several beneficial mites which are either predaceous, like the red velvet mite of apples which feeds on woolly aphis or they may feed on moss and lichen, as the flat scarlet mite (*Tenuipalpus glaber*) or the beetle mite (*Euzetes lapidarius*). The control methods which are given for the injurious species include many new treatments and it is interesting to note that the application of tar distillate winter washes is not an unmixed blessing, for it kills off many beneficial mites.

Inheritance of Flower-Size. There are very few published studies showing how flower-size is inherited in crosses between species with large or small flowers. The memorial volume to the late Prof. Jurius Philiptschenko (*Bull. Lab. Genetics, Leningrad*, No. 9.) contains a paper on this subject by Prof. Ruggles Gates. He has tabulated some thousands of measurements of petal length in four generations of hybrids descended from *Œnothera novæ-scotiæ* × a strain of *Œrubricalyx*. The former species has a mean petal length of about 12 mm., and the latter about 36 mm. This applies to flowers on the main stem. Those on the lateral branches always fluctuate about a mean 2 4 mm. less. The mean petal length of the F_1 hybrids was 18 mm., thus showing incomplete dominance of the small flower. Later generations showed striking segregation in flower-size, the modes for different plants of one culture ranging from 17 mm. to 30 mm. The number of factors for flower-size involved has not been determined, but must be two or perhaps more. Heterozygous plants, which will produce some larger flowered descendants, can be recognised since they show an exceptionally wide range of fluctuation which is generally bimodal. The segregants may breed true or they may again segregate. By tabulating the daily measurements from pure strains, the graphs of fluctuating flower-size can be compared with the changing meteorological conditions. In this way it is shown that a correlation exists between mean flower-size and the weather conditions on the day the flowers opened.

Earthquake Series at Nagusa, Japan. Messrs. A. Imamura, T. Kodaira and H. Imamura have described what they call an "earthquake-swarm" at and near Nagusa on the west coast of the Kii peninsula (*Earthq. Res. Inst. Bull.*, 10, 636–647; 1932). At Wakayama, which lies about three miles to the north of this district, the average number of sensible earthquakes recorded each year from 1911 to 1919 was 14. In 1920, the number rose to 104, increasing to 299 in 1923, and then declining to 142 in 1927. At Hikata, close to the central area, the total number of shocks in the swarm was 934. In May 1929, a network of seismological stations was arranged around the central area, and, from the records obtained at them, the positions of 91 origins were determined. The shocks were all local, few of them were felt more than 12 miles from the centre, and only two or three of the strongest cracked plaster or threw down stone fences. The shocks originated at various places within an area of about twelve miles in diameter in Wakaura Bay, and at depths that seldom exceeded 2½ miles. Two series of levellings along the west coast of the Kii peninsula, separated by an interval of thirty years, reveal a marked change in the level of the land. A block, about six miles wide, from Wakayama to Siotu, has bulged upwards. The maximum uplift is only 3½ in., but the summit of the dome is occupied by a fault along which most of the earthquakes occurred. The uplift is due to lateral pressure acting from north and south, and, with a persistence of the pressure, may end in a fracture. As the Kii peninsula has been the seat of devastating convulsions in the past (for example, in 1854), it is obvious that these earthquakes, weak though they may now be, require careful study.

Earth-Magnetic Effect and the Corpuscular Nature of (Cosmic) Ultra-Radiation. In an important paper with this title (Part 4), read by Prof. J. Clay before the Amsterdam Academy of Sciences on December 17 last, an account is given of a valuable series of observations on the intensity of the cosmic rays, made for him by Dr. J. Berlage on a vessel proceeding from Genoa to Batavia. The ionisation chamber filled with 22 litres of carbon dioxide at a pressure of 11 atmospheres was maintained at 130 volts, and shielded by 13 cm. of iron. The integrated ionisation current during each hour was registered photographically, using an electrometer. The results show a marked decrease from the Amsterdam value ($I = 1{\cdot}83$) to Genoa (1·75), and thence to the magnetic equator (1·56), with a small subsequent rise to Batavia and Bandoeng (about 1·62). Combining these with other recent results, Clay concludes that I is nearly constant from the poles to about magnetic latitude 46° (Amsterdam), and decreases by 16 per cent from there to the magnetic equator. He infers from this and other evidence, which he reviews, that the cosmic rays are corpuscular, having a Maxwellian energy distribution at the hardest end, with a mean energy of 3×10^{10} volts, which is cut off at the lower limit of 4×10^{9} volts by the atmosphere; he attributes the reduction of intensity below about 50° magnetic latitude to the exclusion from this region (according to Størmer's theory) of the less hard components of the radiation. This view implies that the hardness of the observed rays should increase towards the equator, and he quotes observations in support of this.

Relativity of Time. An experiment has been carried out by Kennedy and Thorndike (*Phys. Rev.*, Nov. 1) to verify directly the restricted relativity expression for time in a moving system. Homogeneous light is split into two pencils which traverse paths of different length and are then allowed to interfere.

Assuming the null result of the Michelson-Morley experiment, it is possible to show that the phase relationship of the interfering systems depends on the translational velocity of the system unless the time is given by the Lorentz-Einstein transformation. The experiment therefore consists in building a very stable interferometer and observing the fringes at different parts of the sidereal day, the circumferential velocity of the earth being alternately added to and subtracted from the motion of the solar system in the universe. The interferometer was built entirely of fused silica and was kept in a vacuum in a constant temperature bath. The 5461 line of mercury was excited in a special lamp to give very homogeneous light and a path difference of about 30 cm. was used. Special methods were used to measure the photographs of the interference pattern to 1/1,000 of a fringe. The result showed that the relativity expression was verified, provided that the velocity of the solar system is not less than a few kilometres per second. The apparatus was found to be stable enough to enable comparisons to be made over an interval of six months and thus to utilise the orbital velocity of the earth; and here it was found that an effectively null result was obtained. Since internebular velocities run in thousands of kilometres a second, this is interpreted as meaning that time—as measured by the radiation from a mercury atom—varies according to the Lorentz-Einstein law.

Hæmocyanin of *Octopus vulgaris*. Svedberg and Eriksson (*J. Amer. Chem. Soc.*, Dec. 1932) have determined the molecular weight of the hæmocyanin of *Octopus vulgaris*, the chemical and physicochemical properties of which have been much investigated. The sedimentation method was used and it was found that solutions of the crystallised hæmocyanin contained two constituents, for one of which (called *B*) the sedimentation constant varied strongly with the hydrogen-ion concentration of the solution whilst the sedimentation constant of the other is independent of hydrogen-ion concentration. This second component, called *Ao*-hæmocyanin, is regarded as a definite molecular species, like the hæmocyanins of snails (*Helix*, *Limulus*) previously investigated. It has a molecular weight of about two million, thus resembling the other hæmocyanins, and differing markedly from other proteins. The molecule is not spherical in shape. The molecular weight is the same in the oxygenated and in the reduced state. The results show that the *A* and *B* components are not two different proteins but represent two different kinds of aggregation in equilibrium, the change from *A* to *B* being reversible. This peculiar behaviour with regard to its dependence on hydrogen ion concentration is without parallel in the other proteins so far investigated by the ultracentrifuge method. The hæmocyanin from octopus gave a titration curve with three inflection points, one at pH 4·8, the isoelectric point, one at 6·3 and one at 7·5, the first two being characterised by great change in hydrogen ion concentration when the amount of acid or alkali present is but slightly changed.

Astronomical Topics

Astronomical Notes for February. Jupiter, Mars and Neptune are all near opposition, and are observable for most of the night. The northern hemisphere of Mars is turned towards us; this is less well known than the southern hemisphere, being turned to us at aphelion oppositions. The diameter of Mars increases during February from 12″ to nearly 14″. There is an eclipse of Jupiter IV on February 12; the disappearance is at 8.11 P.M. when Jupiter will be too low; but the re-appearance at 11.54 P.M. is observable. Two stars in the Pleiades are occulted by the moon on February 3, disappearing at 8.43 and 9.34 P.M.

Minima of Algol occur conveniently for observation on February 17 at 11.24 P.M. and February 20 at 8.18 P.M. It should be noted that the times in the B.A.A. Handbook are one day too great from February 18 until the end of April. Mira Ceti reaches maximum towards the end of February, and should be watched; it is only observable very early in the night. Its magnitude at maximum is subject to fluctuations, so comparisons with other stars are useful.

February and March are the best months for observing the zodiacal light in the evening; it should be looked for along the ecliptic as soon as it is dark when the moon is absent.

The central line of the annular eclipse of February 24 crosses Africa; a small partial eclipse is visible in southern Sicily and Greece.

Tidal Shifts in the Earth's Crust. Dr. Hecker announced about twenty years ago that the crust of the earth has tides of a few feet in height. Drs. H. T. Stetson and A. L. Loomis suggested the existence of a much larger shift in a paper read at the recent meeting of the American Astronomical Society at Atlantic City. They have discussed the differences between the time-signals distributed by wireless from the leading observatories of Europe and America, and find discordances between them that are considerably larger than the probable errors of observation. If the whole discordance be ascribed to an actual change in the distance between Europe and America, it would correspond to an oscillation of 63 feet every 12 hours. They also note that the time of transmission of the wireless waves is longer than the light-time for the distance, nearly in the ratio of two to one; they infer that the waves travel by a zigzag route, with about thirty reflections between the Heaviside layer and the surface of the earth or ocean.

Stars of the μ-Cephei Type. Mr. W. Zessewitsch, of Leningrad University Observatory, has sent a note dealing with the double periodicity of stars of the above type. He tabulates for nine stars of the type the shorter period P, the longer period M, the ratio M/P and the logarithm of P. From these data he deduces the following empirical relation between M and P:

$$M/P = 80{\cdot}2 - 44{\cdot}5 \log P + 6{\cdot}7 (\log P)^2.$$

P ranges from 16·5 days to 907 days; M from 600 to 6,200. The above equation gives sufficiently small residuals to suggest that some such equation exists between the two periods. He states that stars of the RR Lyræ type give a similar formula and expresses the hope that it will give a clue to the nature of the pulsations.

Air Waves from Experimental Explosions

By Dr. F. J. W. Whipple, Superintendent of Kew Observatory

IN the article in NATURE of December 31, p. 1008, with regard to the Oldebroek explosions of December 15, it was mentioned that a number of observations had been received at Kew Observatory. The observations have now been scrutinised with the object of arriving at a definite answer to the question whether the waves from the explosions were received in England.

The observations have been put in three classes. Those in Class A were made at such times as were consistent with the passage of the air waves with the normal velocity of sound along the ground or with a delay not exceeding five minutes. The observations placed in Class B were those which were too early or considerably too late, whilst those in Class C were made at such times that there was evidently no connexion with the explosions. There were 12 observations in class A and 10 in Class B. minutes after 6.0. At Farnham (normal time 24·3 minutes) a door gave a short sharp rattle at approximately 6.30 and again at 7.30, that is, 24 minutes after 6.6 and after 7.6. At Arundel (normal time 24·3 minutes) there was a violent rattle of a sash window but the estimate of the time, 6.30, is very rough. At Lymington (normal time 27·7 minutes) a window gave a clear thud at 28 minutes after 7.6.

Observers at Nuneaton and Maidenhead may possibly have heard sounds with the same trajectory as infra-sonic waves. On the other hand, sounds reported at Maldon, Cleethorpes and Boar's Hill, if coming from Oldebroek, were delayed by at least two minutes. In itself that is not improbable, but in view of the facts that none of the three observers in question heard more than one of the four explosions, that another observer at Boar's Hill reported that he could hear nothing and that noises of all sorts are only too common in England, these observations must be regarded as somewhat doubtful.

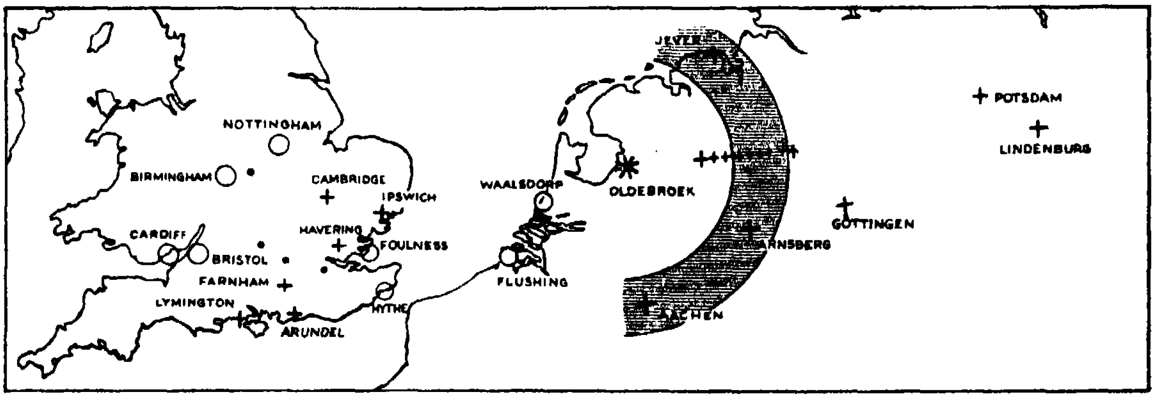

FIG. 1. Sketch map showing places where observations were made on the Oldebroek explosions of December 15, 1932.

+ On the Continent, received by undographs; in England, some evidence of reception of infra-sonic waves.
○ On the Continent, not received by undographs; in England, not recorded by hot-wire microphones.
● Sounds heard *at appropriate times*—Cleethorpes, Nuneaton, Oxford, Maldon, Maidenhead and South Croydon.

Six of the twelve observations falling in Class A refer to secondary sounds such as the rattling of windows. The agreement of these observations with the normal time of passage of air waves is very good. The most satisfactory observations are those at Cambridge. The normal time (reckoned at 3 seconds per kilometre) for waves from Oldebroek to Cambridge is 20·2 minutes. The times that elapsed between the explosions at 6.0, 6.6 and 7.6 and the observations at Cambridge were 21¼, 20½ and 20½ minutes respectively. As the observer noted the first of these receptions when she was awakened by the vibrating motion of the window, a mistake of a minute is not unlikely.

Confirmation by the observations at Ipswich, Havering-atte-Bower, Farnham, Arundel and Lymington indicates that there was a large area over which the aerial disturbance was appreciable. This area lies between the microphone stations at Hythe and Foulness and those at Nottingham, Birmingham, Cardiff and Bristol. It is known now that at none of these stations could the air waves be detected.

At Ipswich (normal time 16·5 min.) a lady felt her bed quiver and heard a faint rumble 16¼ minutes after 6.6. At Havering-atte-Bower (normal time 20·3 minutes) birds were disturbed between 19 and 22

The reception of the air waves at Cambridge at the time appropriate for normal transmission is remarkable. The condition which favours the passage of air waves westwards close to the ground or sea is the presence of east wind, increasing in strength with increasing height, or alternatively, west wind decreasing with increasing height. On December 15, however, the wind was from south-west and moderately strong. Unfortunately, there was much low cloud and no information is available as to the wind at a greater height than 600 metres; at that height the velocity at Felixstowe was about 15 m./s. It is not impossible that the wind fell off rapidly above the lower cloud and that the air wave was therefore able to travel westwards at a moderate height.

On the other hand, the possibility that air waves travelled very rapidly westwards at a great height, so rapidly that the time lost in ascent and descent was compensated, must not be overlooked.

It has been realised since the War that in this part of the world the sounds of explosions produced at points far to the east at distances of 200 km. or more are likely to be heard in summer but not in winter. Accordingly, it may be anticipated that if the Oldebroek experiment is repeated at some time during the coming summer, more positive and therefore more interesting results will be obtained.

I should like to take this opportunity to thank all correspondents who kindly communicated their observations and also to express my appreciation of the trouble taken by the observers who manned all the microphone stations which were in operation.

A preliminary report on the observations made on the Continent has been circulated by Prof. H. Hergesell, president of the International Commission for the Investigation of the Free Atmosphere. Of the German stations provided with undographs close to the direct line from Oldebroek towards Lindenberg, those at distances of 105, 136, 155, 161, 170, 183, 190, 198, 201, 213 and 225 km. were successful in obtaining records of the air waves, as were the stations at Aachen, Arnsberg, Jever, Lindenberg, Göttingen and Potsdam. No waves could be recognised on the undograph records in Holland.

Observations of audibility show an abnormal zone which has, in Germany, a mean radius of 145 km. and a maximum of 215 km. This zone extends to eastern Belgium. The inner zone of normal audibility was narrow; there was some extension to the east, as was to be expected from the prevalence of west wind.

That the air waves were received at places to the east of Oldebroek and not at the principal English stations to the west is in accordance with expectation, as is the fact that there was abnormal audibility in the eastern part of Belgium (south of the source) but not in the western part (south-west of the source). The very small inner radius of the outer zone of reception of air waves, 105 km., is also typical of winter observations. The reception of air waves at Cambridge and other places in England was unexpected and therefore, if the evidence is accepted, all the more interesting.

It is understood that the experimental explosions which were to have taken place in Novaya Zemlya on the same morning as the Oldebroek ones had to be postponed.

Similar experiments, organised by Dr. Bruno Rolf, were to be inaugurated in Sweden on January 11 by the explosion of 300 kgm. of guncotton near Boden. Five undographs provided by the International Meteorological Association were to be used for the first time on this occasion.

British Industries Fair

SCIENTIFIC INSTRUMENT SECTION

THE Scientific Instrument Section of the British Industries Fair will again be situated in the Grand Hall at Olympia. Of the 14,500 sq. ft. of space to be occupied by this section of exhibitors, nearly a quarter will be taken up by the composite exhibit of a group of British scientific instrument manufacturers who have co-operated for this purpose. The whole of the exhibits may roughly be divided into two categories, namely, (*a*) technical instruments and apparatus, such as are used for control and testing in works, for laboratory research or for the teaching of science in colleges and schools; (*b*) scientific instruments of a more or less domestic character, such as barometers and thermometers. A very wide field of scientific instruments will thus be covered, ranging from a simple pocket magnifying lens to the equipment required for the most refined micro-photographic work.

Among the new, improved, or adapted products of the instrument industry, about which advance information is available, the following may be mentioned. James Swift and Son, Ltd., will exhibit Nicol and other polarising prisms such as are used in the latest apparatus for television and picture transmission. A new model of the tintometer, very light and portable, and enabling rapid measurements to be made, will be shown by The Tintometer Ltd. This instrument enables the specification or definition of colour to be made in terms of reproducible units or standards, in the form of graduated and numbered glass slides. A stereo-prism binocular, with an extra wide field, a magnification of 7 diameters, and a 50 mm. object-glass, having a light-transmitting power very greatly in excess of that of any prism binocular previously made, will be one of the exhibits of Ross Ltd. Among other products, W. Watson and Sons, Ltd., will show a new low-power microscope for the rapid examination of specimens varying in thickness from 1 mm. to 6 in. This firm's exhibits will also include a special microscope 'for crime detection' and a new form of photometer for the measurement of the comparative densities of photographic plates and for the measurement of reflections from papers and other materials. This last instrument makes use of a photoelectric cell with a suitable magnifying system.

The Foster Instrument Company is exhibiting at the Birmingham Section and, besides a complete range of automatic temperature controllers, will show a 'Blackie Heat-Loss Gauge'. This last named instrument, it is claimed, is the only known instrument of its kind, and, since it is directly calibrated in B.T.U's / sq. ft. / H.R., it can be used even by unskilled operators.

Thermometers reading to an extremely high degree of precision—for example, to the nearest 0·005° C.—for use in research and industrial work will also be among the exhibits at Olympia.

Another noteworthy exhibit will be the projection microscope to be shown by Vickers. It is designed primarily for the purposes of metallography, and will deal with specimens up to 50 lb. in weight and enable magnifications varying from 3 to 5,000 diameters to be obtained. The apparatus will, as desired, provide for visual observations, or take photomicrographs or project the images on to a screen for demonstration purposes. The Cooke optical comparator is designed for the quick and accurate comparison of machine parts produced in quantities. It is intended to supersede the use of high and low limit gauges in works' inspection departments. A total magnification of 1,000 is achieved by means of a system of mechanical and optical levers, and a variation of 0·0001 in. from the standard can be detected. An instrument for observing the precise character of the movement of any rotating or oscillating part of a machine or apparatus is the 'Whidbourne' stroboscope. By means of this instrument—to take one example—gear wheels can be observed in motion without having to stop the machine. The observer, on looking through the stroboscope, sees the gear wheels apparently stationary, and can thus readily detect any defects. Analytical balances will be shown which, it is claimed, will at least equal, if not surpass, the corresponding foreign balances which were widely used until a few years ago. In these balances the beam is made of an alloy having a negligible coefficient of expansion. One special balance has been designed for the estimation of moisture in tea, tobacco, flour and other materials.

Of the various instruments and apparatus used for instructional purposes in schools and colleges, mention may be made of the 'Simplex' ripple projector which throws on to a screen images of wave forms and motions, the ripples being produced in a glass trough by means of an electro-magnetic vibrator. This instrument enables experiments to be made showing, for example, the effect of sound in rooms and halls of various shapes.

Of the numerous other exhibits that will be on view in the Scientific Instrument Section of the Fair we have space merely to mention the 'Stormoguide', an instrument designed to 'forecast' the weather, and two popular British-made cameras at low prices—one fitted with an anastigmat 3·5 lens at 75*s*., and the other a 3¼ in. × 2¼ in. box camera at 6*s*. 6*d*.—the lowest priced camera, it is claimed, on the market.

Altogether, the visitor will find scientific exhibits of abundant interest at Olympia.

Prevention of Roof Falls in Mines

DURING the early years of the Safety in Mines Research Board in Great Britain, the staff recruited consisted almost exclusively of chemists with no actual mining experience. Their energies were directed towards chemical aspects of the safety problem, and in particular to the phenomena of explosions, a study which lends itself readily to laboratory investigation. Calamitous as gas or dust explosions may be, the reports of the Secretary for Mines show that they normally account for only about five per cent of the total fatal accidents occurring annually in the coal mines of Great Britain, whereas the fatalities caused by falls of roof or sides account for approximately fifty per cent. Thus whilst explosions create most public interest in the safety of mines, falls of roof and sides cause by far the most casualties.

The activities of the 'Safety in Mines' movement have now been extended to include a co-ordinated research on the causes of falls of roof and their prevention. In consequence of the great variation in mining conditions, these investigations are being carried out in all the important coalfields of Great Britain. They are under the direct supervision of committees consisting of leading mining engineers in the respective areas. Progress reports are circulated periodically. The North of England Institute of Mining Engineers (Support of Workings in Mines Committee) has just issued a pamphlet, "Safety in Bord and Pillar Whole Workings", for free circulation among all concerned. The 'bord and pillar' method of mining, that is, dividing a coal seam into a system of large squares or blocks ('pillars') by first developing narrow roadways (called 'bords' and 'walls') and afterwards extracting the coal left in the 'pillars', is extensively adopted in the Northumberland and Durham coalfields. The factors involved in the movement of the overlying strata when driving the narrow roadways are discussed together with the best methods of controlling the roof movements. Measurements have shown that the rate of roof movement is greatest closely adjacent to the working face and, hence, the necessity of effectively supporting this critical area so as to reduce the danger of fracture of the roof with consequent falls is stressed by the Committee.

In addition to the circulation of this pamphlet a cinematographic film has been made showing a system of coal-getting at a Northumberland colliery where the methods of roof support advocated are now in use. This film is to be exhibited throughout the northern coalfield.

Fatigue Limit of Medium Carbon Steel

IT has been known for some time that iron undergoes several small changes at temperatures between that of the room and say, 350° C. These changes can be detected by variations in several physical properties and also appear to have some influence on the mechanical properties of the material. So far, however, no attempt has been made to investigate any effect of these change points on the fatigue limit of the metal. A paper by Mr. J. W. Cuthbertson, read before the September meeting of the Iron and Steel Institute, endeavours with considerable success to fill this gap in our knowledge. He has shown that the fatigue limit of a medium carbon steel rises as the temperature is increased to about 90° C. It then falls very rapidly, and at 120° C. or thereabouts, is less than at room temperature, to what degree, however, is still unsettled. As the temperature is still further increased the fatigue limit rises again very rapidly and at about 190° C. is some three tons per square inch higher than at room temperature. A second rapid drop then ensues, and a minimum occurs at about 220° C. followed by a further small rise. In an atmosphere of nitrogen the increase is progressive up to at any rate 350° C., but in air the fatigue limit begins to fall when the temperature exceeds about 300° C. The marked depression around 120° C. particularly is an observation of very great interest.

The paper, further, is of importance in connexion with the general measurement of fatigue limits. One method which has been suggested for their rapid determination is to plot the load deflection curve which, at first a straight line, shows a change in direction when the fatigue limit is attained. The method, however, has not been deemed completely satisfactory since certain cases are known where the results have differed appreciably from those obtained in the normal long time tests.

Mr. Cuthbertson has gone far to show that if this method is so modified that the load is steadily applied and is not increased suddenly, the results obtained are far more satisfactory, and as a practical test at any rate the method would appear to have very valuable applications.

University and Educational Intelligence

CAMBRIDGE.—Dr. G. Salt, research student of Gonville and Caius College, has been elected as first holder of the Stringer fellowship, tenable at King's College, which is open to graduate members and research students of the University whose study and research fall within the fields of chemistry, experimental physics, or the chemistry or physiology of plant or animal life. Dr. Salt is a B.Sc. of the University of Alberta, and Sc.D. of Harvard University. He was elected to a Royal Society Moseley Research Studentship in 1932.

"WHAT is General Science ?" An editorial on this question in the October number of the *Progress of Education* (Aryabhushan Press, Poona; monthly, 12 annas) criticises the course proposed by the Academic Council of the University of Bombay in view of the inclusion in the matriculation syllabus of general science in place of the four alternative groups, physics and chemistry, botany and zoology, physiology and hygiene, and domestic science. The proposed course consists of only the elementary study of physics and chemistry, botany and zoology and physiology and hygiene, and the article points out that whilst this is perhaps advantageous to those who will later specialise in science, it is ill-adapted to the professed object of the change in the syllabus, namely, to equip every student with that modicum of scientific knowledge which is indispensable for the intelligent appreciation of his material environment, a knowledge as necessary to-day as that of language, history, or arithmetic. The scope of modern science and its applications is so vast that there cannot be at the matriculation stage the same general science for students with all sorts of environments and there should be, it is suggested, a choice of several courses which would include (*a*) for students in big cities—mainly physics and chemistry; (*b*) for those in rural areas—mainly agriculture and allied topics; (*c*) for industrial areas—practical arts like weaving, wood or iron work, machine repairs, printing, moulding; (*d*) for girls—domestic science; (*e*) for all—science of health. After matriculation, the student should supplement this course until he has acquired such further knowledge of science as he will need, not as a specialist in science but as a man of culture.

THE problem of improving examination methods has received much more attention in the United States than in Great Britain, and the Carnegie Corporation has spent large amounts in recent years in devising objective tests in modern languages. It has now taken steps to further investigations in Great Britain, and, as a result of a private international conference held in 1931 at Eastbourne, under the auspices of the Carnegie Corporation, the Carnegie Foundation, and the International Institute of Teachers College, Columbia University, five independent committees have been set up, and promised a grant for three years, in England, Scotland, France, Germany, and Switzerland, to investigate such problems connected with examination systems of the countries concerned as they deem desirable. The English "International Institute Examinations Enquiry" Committee is constituted as follows :—Sir Michael Sadler (chairman), Dr. P. B. Ballard, Dr. C. Delisle Burns, Prof. Cyril Burt, Sir Philip Hartog (director), Sir Percy Nunn, Prof. C. Spearman, and Prof. Godfrey H. Thomson (replacing the late Prof. Graham Wallas, who was an original member of the Committee). The Scottish Committee, which is a committee of the Scottish Council for Research in Education, is constituted as follows :—Prof. Godfrey H. Thomson (convener), Dr. William Boyd, Prof. James Drever, Mr. Thomas Henderson (honorary secretary), Mr. W. A. F. Hepburn, Dr. J. Mackie, Prof. W. W. McClelland, Dr. Robert Rusk, and Dr. J. C. Smith. The chairman of the French Committee is M. Desclos, Sous-Directeur, Office National des Universités et des Ecoles Françaises, Paris; the chairman of the German Committee is Prof. C. H. Becker, formerly Prussian Minister for Education, and the chairman of the Swiss Committee is Prof. A. Malche, professor of pedagogy in the University of Geneva.

Calendar of Nature Topics

February Fill-dyke

In western Europe, February is proverbially associated with flowing streams and a damp countryside. In the French Revolutionary Calendar of 1793, the period January 20–February 18 was the month 'Pluviôse' or 'rainy', but even allowing for its shortness, February is no rainier than January or March. The name 'Fill-dyke' may have originated from the melting of the January snows, but during the present century deep snow has been rare. The title is still justified, however, for in winter evaporation is negligible and the rains of December and January replenish the underground reservoirs and leave the soil in a water-logged condition. Thus the streams are often at their highest in February and fall rapidly under the drying conditions of March.

Tilling the Soil

Writing in 1661, Mathew Stevenson in "The Twelve Moneths" says of February : "Now methinks I see the Husbandman dresse afresh his rusty plowshare to teare up the stiffer clay grounds . . ." Although mechanical science has greatly improved the structure and design of cultivating implements, until quite recently all the major cultivations, whether by horse or tractor, were on the age-old principles of the turning action of the plough or the shattering effect of the hoe. A new system is now being introduced and scientifically examined. Rotary tillage, the milling of the soil by revolving tines, instead of the bodily movement or disturbance by the drawn implement, is the most natural way in which the internal combustion engine can be directed to the comminution of the soil. Rotary cultivation is gaining ground in small occupations, where it is employed as a substitute for the joint action of spade and rake; but larger machines are being developed for full-scale cultivation, where they will do in one operation the work of tractor plough and the cultivators and harrows which follow them. The aim of all cultivation should be, so far as possible, to let the weather do the work. Alternate wetting and drying, frost and thaw, have a wonderful mellowing effect on soil, and this greatly assists the formation of a seed-bed whether by the older or newer implements. To force a tilth against the weather is an expensive operation and at best only a makeshift; but in case of need the rotary cultivator presents more opportunities in this direction than the traditional implement.

February 1. Partridge Shooting Ends

The close of the partridge shooting season is adjusted to avoid disturbance of the new season's crop of partridges, for during February the birds begin to pair. Indeed, pairing sometimes begins in January and may be delayed until March, but a mean date about mid-February justifies the end of the legal open season. The courtship period is prolonged, for eggs are scarcely to be expected until the beginning of May, and although there is an absence of the elaborate plumage displays in which many game-birds indulge, the excitement of the occasion is expressed in challenges between cocks and continual 'scrapping'.

Frost and Shore Animals

In February 1855, when Robert Chambers was in the chair, Hugh Miller described to the fellows of the Royal Physical Society of Edinburgh his experience of the result of "the late severe frost" upon the shore animals of the Firth of Forth. "The present intense frost, coincident at new moon with a stream tide, has killed many of the littoral shell-fish around our shores, and they now lie by thousands and tens of thousands along the beach. On the beach below Portobello, and for at least a mile on the western side of the town, they are chiefly of two species—*Solen siliqua*, or the edible spout-fish or razor-fish, and *Mactra stultorum*, or the fool's cockle, both of them molluscs which burrow in the sands above the low water mark of stream tides. The spout-fishes when first thrown ashore were carried away by pail and basketfuls by the poorer people, and yet of their shells enough remain, in the space of half a mile, to load several carts; but the fishes themselves, devoured by myriads of birds, chiefly gulls, have already disappeared. The Mactra, though they may be picked up in some places by basketfuls, are less abundant. . . . Their wholesale destruction by a frost, a few degrees more intense than is common in our climate, strikingly shows how simply, by slight changes of climate induced by physical causes, whole races of animals may become extinct. It exemplifies, too, how destruction may fall upon insulated species, while from some peculiarity of habitat, or hardiness of constitution, their conquerors escape. There are two species of Solen in the Firth, *S. siliqua* and *S. ensis*; but we have not seen, on the present occasion, a single dead individual of the latter species; and of at least four species of Mactra, *Mactra stultorum* seems alone to have suffered." Later on, Hugh Miller found, in addition to these two species which at first were almost exclusively cast up, considerable numbers of smaller molluscs, amongst which *Solen ensis* was represented. Of the smaller forms *Tellina fabula* suffered most.

Frost as an agent of death was apparently selective; but absence of knowledge about the relative numbers of different species living on the shore in question, made speculation hazardous. Hugh Miller was satisfied, however, that "none of the molluscs killed in any considerable abundance by the present intense frost seem to be truly arboreal species".

Selective Mortality in Shore Waters due to Frost

A recent example, in which successive annual populations have been compared, supplies the data which Miller lacked. The early months of 1929 brought a spell of exceedingly cold weather which was duly recorded in the temperature readings taken in the sea at the oyster beds of Blackwater Estuary. The average temperature is lowest in mid-January, when for the years 1926–28 it reached slightly under 4° C. The seashore differs from the open sea in that its water temperature shows little of the lag which throws the minimum temperature of the ocean back into March, because of the readiness with which shallow waters cool and of the inflow in estuaries of chilled fresh water from the land. Therefore exceptionally cold air temperatures were reflected over the oyster beds, so that in February 1929 a minimum water temperature of less than $-1°$ C. was recorded. (See J. H. Orton and H. M. Lewis in *J. Mar. Biol. Ass.*, 17, 301–313; 1932: and J. H. Orton in *Acta Phænologica*, 1, 129–132; 1932.)

The result was selective destruction of the molluscs associated with the oyster beds. In 1928 the relative percentages, amongst 1,730 individuals, of three well-known species were: *Urosalpinx cinerea* 7·8 per cent, *Murex* (*Ocinebra*) *erinacea* 41·2 per cent, *Purpura* (*Nucella*) *lapillus* 51 per cent. After the great frost in 1929, the relative percentages were respectively:—1929—83·4, 0 1, and 16·6, in a total of 1,184 individuals; and in 1930—84·5, 0·1, and 15·4, in a total of 7,927 individuals. There can be little doubt that the mortality traceable in the *Murex* figures was due to the unusual conditions. Further, it was noted that on the Whitstable oyster beds, where the sea-urchin *Psammechinus miliaris* was abundant in the years 1920–28, so that Prof. Orton could obtain samples of five hundred individuals without difficulty, after the opening months of 1929 the species entirely disappeared on the shallower inshore grounds, where the hydrographical conditions are similar to those over the Blackwater beds. But in small numbers the sea-urchin could still be obtained in the deeper off-shore waters.

Societies and Academies

LONDON

Royal Society, Jan. 19. C. N. HINSHELWOOD, E. A. MOELWYN-HUGHES and A. C. ROLFE: The combination of hydrogen and oxygen in a silver vessel. The reaction shows the characteristics of a surface reaction up to 700°. There is no sign of the development of reaction chains in the gas. The inhibition of the gas reaction is attributed to the catalytic destruction at the silver–silver oxide surface of the active species which would normally propagate the chains. R. L. Smith-Rose: The electrical properties of soil for alternating currents; with particular reference to radio-frequencies. The first part of this paper comprises a summary of previous investigations of the conductivity and dielectric constant of soil at various frequencies from 50 cycles per second up to 200 million cycles per second. The second part of the paper describes the application of a laboratory method for measuring these constants on samples of soil taken from selected sites at the National Physical Laboratory, Teddington. The conductivity varies from less than 10^6 E.S.U. for dry soil, up to a value of approximately 10^8 E.S.U. for normal moisture content. Corresponding values for the dielectric constant range from 2 or 3 for dry soil up to about 20 for moist soil at high radio frequencies. Measurements on a number of samples of soil taken at random from several other sites are included, and show that both the normal moisture content and the conductivity can have values which are appreciably higher than those experienced at Teddington. The paper concludes with a brief discussion of the penetration of radio-frequency currents in the earth, and the effective depth of penetration has been calculated in some instances. C. B. O. Mohr and F. H. Nicoll: (1) Inelastic electron scattering in gases. The angular distribution of inelastically scattered electrons has been investigated in helium, argon and mercury vapour for the angular range between 20° and 160°. The scattered electrons of different energies were sorted out by a uniform radial electrostatic field. The results suggest that the problem of the scattering of electrons by atoms is not so serious as might be expected from a consideration of the various complicating processes which are involved, and that in the explanation of the observed results for the elastic and inelastic scattering of electrons by the heavier atoms, it is merely the 'size' of the atom which is of fundamental importance. (2) The large angle scattering of electrons in gases (2). With an apparatus described in a previous paper the angular distributions of scattered electrons have been measured to 160° for 30-150-volt electrons. The elastic scattering has been investigated in hydrogen, carbon dioxide, nitrogen, neon, methane, hydrogen sulphide, and phosphine, while the inelastic scattering has also been measured in the first four gases. The diffraction maxima and minima which appear in the inelastic angular distributions are closely similar to those obtained for the elastic scattering. The curves for the elastic scattering show a gradual change in form for successive elements in the periodic table. The general shape of the experimental curves for the elastic and inelastic scattering is qualitatively accounted for, with the aid of a simple picture involving merely the 'size' of the atom.

Paris

Academy of Sciences, Dec. 5 (195, 1049–1112; 1932). L. Cayeux: The modes of existence of glauconite in limestone. A discussion of the relation between the presence of glauconite and Foraminifera in limestone. Edm. Sergent, A. Donatien, L. Parrot and F. Lestoquard. The experimental suppression of sexual reproduction in *Theileria dispar*. In this organism, which by the artificial means of blood transfusion is perpetuated by schizogonic multiplication, the sexuality disappears. As a practical consequence, a benign virus of theileriosis can be used as a vaccine without creating carriers of dangerous germs. Bertrand Gambier: The intersection of two plane algebraical curves. Jacques Devisme: A quasi-Euclidian space of three dimensions connected with P. Humbert's equation. Maurice Gevrey: Complements to a preceding note on systems of the parabolic type: problems with non-linear limits. Ed. and G. Guillaume: The definition of the unit of value. René Lucas: The diffraction of light by elastic waves. G. A. Beauvais: The total reflection of Hertzian waves. Experimental study of the reflection of Hertzian waves (18 cm. wave-length) by a paraffin wax prism. Max Morand and A. Hautot. The fine structure of the carbon line K_α. The line is complex and contains at least two components: the approximate distance of the two components is 0·6 A. Adrien Karl: The analysis of primary radioactive minerals. The method is based on the treatment at 500°–550°C. with carbonyl chloride, thus removing metals forming volatile chlorides. Jean Galibourg: Certain singularities of the extension curves of steels at high temperatures. P. Vallet: Study of the decomposition of some complex platinum compounds at progressively increasing temperatures. Experiments on the reduction of chlorplatinic acid and its salts, with the view of preparing finely divided platinum at the lowest possible temperature. A. Perret and A. M. Krawczynski. The action of some organo-mercury compounds on solutions of hexamethylene-tetramine. R. Sutra: The acetolysis of starch. P. Carré and D. Libermann. The mechanism of the reaction of phosphorus pentachloride on neutral alkyl sulphites. The primary reaction gives phosphoryl chloride, alkyl chloride and the chloride AOSOCl, where A is the alkyl group. Four secondary reactions may occur, depending on the temperature. Ch. Prévost. A colouring matter derived from tripropynylcarbinol. Hubert Cerf: Researches on the nitro-amines. Aurélio Cocco: A new method of amination of organic compounds. Paul Gaubert. The rotation of crystals floating on the surface of liquids. H. Lagotala and Ch. Couchet. The tectonic on the French Congo. Louis Mengaud: The structure of the Cantabrian chain. P. Russo: The tectonic significance of the folds with reference to the Eocene to the east of Kasbah Tadla (Central Morocco). Albert de Lapparent: The neighbourhood of Bauduen (Var). Francis Ruellan: A bank of shingle and a fossil sea floor in the cliffs of Trez-Bihan at Telgruc (Finistère). G. Grenet: The geothermic gradient in Limagne. Advantage was taken of a 200 metre boring to measure the temperatures at a depth of 192 metres and at the ground level. The results were in good agreement with the earlier observations of Macholles, confirming the view that the geothermic gradient is of the order of 14 metres over the greater part of the Limagne. A. Savornin: Some measurements of magnetic anomalies at Madagascar. Data are given for 23 stations: the observations were made in May and June, 1932. L. J. and F. Mercier: A new method of preparing marrubiine. A simplification of Gordin's method of extraction from the plant, yielding a crystalline product melting at 3° C. higher than Gordin's product. Em. Miège: The anabiosis and revitalisation of wheat embryos. Alexandre Lipschütz: New researches on the transplantation of ovaries preserved outside the organism. An ovary, isolated and kept at 12°-18° C. for eleven days, has survived as an intrarenal graft for two years: another dried before transplantation, after losing about 40 per cent of its weight, has survived as an intrarenal graft for 30 months. P. Chevey: The nature of the influence exercised by the inundated forest of the Grand Lac of Cambogia on the velocity of growth of fishes. Mlle. Yvonne Garreau: The oxidation products of levulose by ammoniacal copper carbonate and atmospheric oxygen, in dilute solution, pH = 7, and at the ordinary temperature. Oxalic acid and oxymethyl-4-imidazol were identified among the oxidation products. A. Rochaix, P. Sédallian and Mme. Clavel: Inhibiting properties towards *A* paratyphic, shown in paratyphic cultures.

Geneva

Society of Physics and Natural History, Nov. 3. G. Tiercy and P. Berger: Note on aerological soundings and the wind gradient in Switzerland. Pilot balloons give very uncertain results. The theoretical equation for the vertical movement of pilot balloons shows that the upward velocity of the balloon is continually varying, starting from the ground. The velocity of the wind theoretically calculated and based on good observations in the mountains corresponds better with the true wind velocity. G. GUTZEIT and R. MONNIER: The utilisation of some azo derivatives of oxyquinoline as reagents in qualitative analysis. In a preliminary study, the authors describe the spot colour reactions of the cations of the heavy metals with several azo derivatives of oxyquinoline. The presence of a sulpho group in the substituted molecule makes the colour reactions more clear. H. LAGOTALA: The stratigraphical study of the Mindouli-Mines region. The author makes clear the stratigraphical complexity of this part of the French Congo, due to numerous faults leading to repetition of facies. J. WEIGLE: Dispersion in the Hertzian domain. Experiments show indubitably that polarised molecules dissolved in a viscous medium associate in part to form large groups in the solvent. Certain X-ray measurements had suggested this arrangement, but the full proof had been lacking up to the present.

Forthcoming Events

Monday, Jan. 30

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—(Geographical Film).—Lieut.-Commander J. L. F. Hunt: "The Sahara and the Ivory Coast".

Wednesday, Feb. 1

UNIVERSITY COLLEGE, LONDON, at 5.30.—K. Ryde: "The Reference Library of a Modern Town and What it Can do for You".

Thursday, Feb. 2

UNIVERSITY COLLEGE, LONDON, at 5.30.—(Newmarch Lectures in Statistics).—Dr. L. J. Comrie: "Modern Methods of Calculation" (succeeding lectures on Feb. 9, 16, 23, March 2 and 9).

Official Publications Received

GREAT BRITAIN AND IRELAND

The Quarterly Journal of the Geological Society of London. Vol. 88, Part 4 (second half), No. 352 (second half), December 29th. Pp. 711–916 + plates 47–62. (London: Longmans, Green and Co., Ltd.) 7*s*. 6*d*.

Quarterly Journal of the Royal Meteorological Society. Vol. 59, No. 248, January. Pp. 94. (London: Edward Stanford, Ltd.) 7*s*. 6*d*.

The Slaughter-House Problem: being the eleventh Benjamin Ward Richardson Memorial Lecture delivered before the Moden Abattoir Society at the Royal Sanitary Institute on November 30th, 1932. By T. Topping. Pp. 16. (London: Model Abattoir Society.)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 8, No. 1, January. Pp. 105. (London: Cambridge University Press.) 12*s*. 6*d*. net.

The Proceedings of the Physical Society. Vol. 45, Part 1, No. 246, January 1. Pp. iv + 133. (London: Physical Society.) 7*s*. net.

Medical Research Council. Special Report Series, No. 176: Third Report of the Miners' Nystagmus Committee. Pp. 36. (London: H.M. Stationery Office.) 9*d*. net.

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 2, No. 14: Submarine Faulting in Kimmeridgian Times—East Sutherland. By Prof. E. B. Bailey and Dr. J. Weir. Pp. 429–467 + 3 plates. 6*s*. Vol. 57, Part 2, No. 15: Development and Probable Evolution of the Suctorial Disc in the Tadpoles of *Rana afghana* Gunther. By Dr. Sunder Lal Hora. Pp. 469–472 + 1 plate. 1*s*. Vol. 57, Part 2, No. 16: The Innervation of the Uterus. By Dr. Amy M. Fleming. Pp. 473–490 + 4 plates. 4*s*. Vol. 57, Part 2, No. 17: Contributions to the Study of the Old Red Sandstone Flora of Scotland. 8: On Arthrostigma, Psilophyton, and some associated Plant-Remains from the Strathmore Beds of the Caledonian Lower Old Red Sandstone. By Dr. W. H. Lang. Pp. 491–521 + 4 plates. 5*s*. 6*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Twenty-fifth Annual Report, 1931–32, presented by the Council to the Court of Governors on the 25th October, 1932. Pp. 44 + 5 plates. (Cardiff.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 72, No. 433, January. Pp. 92 + xxii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

OTHER COUNTRIES

Indian Lac Research Institute. Annual Report for the Year 1st April, 1931, to 31st March, 1932. Pp. 44. Bulletin No. 10: The Influence of Orpiment in Shellac on the Protective Properties of the Varnish. By M. Rangaswami. Pp. 8. 8 annas. (Nankum, Ranchi.)

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 15: July, August, September, 1932. By Ernest A. Hodgson. Pp. 247–261. (Ottawa: F. A. Acland.) 25 cents.

Indian Forest Records. Vol. 15, Part 5: Provisional Volume Tables and Diameter Growth Curve for Semal (Bombax malabaricum DC.) in the Central Provinces. By Ishwar Das Mahendru. Pp. ii + 6. 2 annas; 3*d*. Vol. 15, Part 6: Branch Smallwood Tables for Shorea robusta, Tectona grandis, Cedrus deodara, Pinus excelsa and P. longifolia. Pp. iii + 7. 3 annas; 4*d*. (Calcutta: Government of India Central Publication Branch.)

Journal of the Faculty of Science, Hokkaido Imperial University. Series 4: Geology and Mineralogy. Vol. 1, Nos. 3–4, November. Pp. 257–390 + plates 19–52. (Sapporo.)

Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1932. (Publication 3183.) Pp. vii + 89. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 81, Art. 18: On a Newly Mounted Skeleton of Diplodocus in the United States National Museum. By Charles W. Gilmore. (No. 2941.) Pp. 21 + 6 plates. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Geological Survey. Fifty-third Annual Report of the Director of the Geological Survey to the Secretary of the Interior for the Fiscal Year ended June 30, 1932. Pp. ii + 94. 10 cents. Bulletin 837: Tertiary and Quaternary Geology of the Lower Rio Grande Region, Texas. By A. C. Trowbridge. Pp. viii + 260 + 45 plates. 75 cents. Professional Paper 174: Physiography and Glacial Geology of Eastern Montana and adjacent Areas. By William C. Alden. Pp. viii + 133 + 51 plates. 1 dollar. (Washington, D.C.: Government Printing Office.)

Ceylon Journal of Science. Section B: Zoology and Geology. Spolia Zeylanica. Edited by Dr. Joseph Pearson. Vol. 17, Part 1, October 11th. Pp. 71 + 11 plates. 3 rupees. Vol. 17, Part 2, November 3rd. Pp. 73–148 + plates 12–27. 3 rupees. (Colombo: Colombo Museum; London: Dulau and Co., Ltd.)

The University of Colorado Studies. Vol. 20, No. 1: Abstracts of Theses for Higher Degrees, 1932. Pp. 113. (Boulder, Colo.). 1 dollar.

India: Meteorological Department: Scientific Notes. Vol. 4, No. 45: The Method of Coincidences, or a Quick Method of Determining the Approximate Value of a Simple Correlation Co-efficient. By Dr. S. R. Savur. Pp. 152–156. 3 annas; 4d. Vol. 5, No. 47: Horizontal Atmospheric Visibility at Quetta. By A. K. Roy. Pp. 17 + 3 plates. 8 annas; 10*d*. (Calcutta: Government of India Central Publication Branch.)

Institute scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Rédigé par Dr. K. W. Dammerman and Prof. Dr. H. C. Delsman. Vol. 7, Suppl., Livraison 7, Novembre. Pp. 349–387. (Buitenzorg: Archipel Drukkerij.)

Field Museum of Natural History. Botanical Series, Vol. 11, No. 4: New Plants from British Honduras. By Paul C. Standley. (Publication 316.) Pp. 129–142. (Chicago.) 25 cents.

State of California: Department of Agriculture, Sacramento. Special Publication No. 109: The California Ground Squirrel Control Program. By Eugene S. Kellogg. Pp. 21. (Sacramento, Calif.: California State Printing Office.)

U.S. Department of Agriculture: Biological Survey. Report of the Chief of the Bureau of Biological Survey. Pp. 30. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 81, Art. 4: The Marine and Fresh-Water Sponges of California. By M. W. de Laubenfels. (No. 2927.) Pp. 140. (Washington, D.C.: Government Printing Office.)

The Imperial Council of Agricultural Research. Scientific Monograph No. 2: Life-Histories of Indian Microlepidoptera (Second Series); Alucitidae (Pterophoridae), Tortricina and Gelechiadae. By T. Bainbridge Fletcher. Pp. ii + 58 + 35 plates. (Calcutta: Government Printing Office.) 3.4 rupees; 5*s*. 6*d*.

Mysore Geological Department. Records, Vol. 30, 1931. Pp. iv + 80. (Bangalore: Government Press.) 2 rupees.

Malta. Annual Report on the Working of the Museum Department during 1931–32. Pp. xiv. (Malta: Government Printing Office.)

Stanford University Publications: University Series. Engineering, Vol. 1, No. 1: Some Experiments on Oil Films in Complete Cylindrical Bearings. By Prof. Guido H. Marx; in collaboration with Jean B. Balcomb, Edwin O. Bennett, Jean Dentraygues, Walter K. Franklin, Boynton M. Green, Richard H. Hartman, Rhodus MacKamey, William L. Rifenberick. Pp. 110. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press.) 1 dollar.

Contributions from the Department of Geology of Stanford University. Vol. 1, No. 3: Recent Littoral Foraminifera from Texas and Louisiana. By M. M. Korufeld. Pp. 75–102 + plates 13–16. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press.) 75 cents.

Proceedings of the Nineteenth Indian Science Congress, Bangalore, 1932 (Third Circuit). Pp. xxxvii + 540. (Calcutta: Asiatic Society of Bengal.) 16.12 rupees.

National Research Council. Organisation and Members, 1932–1933. Pp. ii + 68. (Washington, D.C.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Fourth Series (Biology), Vol. 7, No. 4. Pp. 457–573 + plates 13–17. (Tokyo and Sendai: Maruzen Co., Ltd.)

Institute for Science of Labour. Annual Report of the Director of the Institute for Science of Labour for 1930–1931. Pp. ii + 25. (Kurasiki.) 60 sen.

CATALOGUES

Acriflavine 'B.D.' in General Practice. Pp. 12. (London: The British Drug Houses, Ltd.)

Zeiss Nachrichten. Heft 2, Dezember. Pp. 32. (Jena: Carl Zeiss.)

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Petroleum Technology and Chemical Industry

If we survey the course of evolution of petroleum technology, particularly as it concerns the treatment, refining and utilisation of crude oil and its products, it is an impressive fact that despite a magnitude of growth and ramifications of the industry it supports in modern life, equally an obvious dependence throughout on the functions of certain applied major sciences, it has long maintained, outwardly at all events, a remarkable measure of autonomy. No one ever seriously suggested, because chemistry and physics, for example, enter largely into the technique of manufacture of innumerable products from the raw material, that this technology is *ipso facto* an offspring of co-ordinated influences of these or any other sciences. On the contrary, oil technology has grown in an almost unique fashion. It has been urged by an overwhelming but universal impulse. It has rapidly strengthened from an innate knowledge of its inherent power as a world force, casually absorbing, but diligently applying, just those established principles of appropriate natural science as would meet its needs. It has known few of the struggles of just as important, but none the less subservient, industrial technologies.

No one science nor the more mundane interests of international, economic and political life, which petroleum has profoundly influenced in latter years, can legitimately claim any fundamental control over the technology even now. There are signs, however, that this order of things is destined to change, if indeed the change is not now actually taking place.

In a welter of conflicting difficulties through which the industry has been and still is passing, certain facts stand out as pre-eminent in any consideration of the situation. Over-production, not only of crude oil but also of many of its products; waste; curtailed consumption; increasing competition with commodities serving similar purposes but derived from different raw materials; vicissitudes of current international commerce; all these combine to create within the industry an acute self-consciousness of stifled activity, probably for the first time in its history. The repercussions of this have not been without their corresponding reaction on the technology. No one can really see far ahead with precision. Even the convictions of those who profess to know carry little more than temporary weight, since they seem to lack firm and definite foundation in a much disturbed ground.

Into this bewildering maze of circumstances there has been flung, with considerable force recently, the challenge of synthetic oil from hydrogenation process. What is the significance of this incursion? It is inconceivable, aside from all economic argument, that this factor in the situation can be other than one to be seriously reckoned with; it is disturbing even now; it is bound to be formidable ultimately in the petroleum industry, and to have far-reaching consequences on the technical operations involved therein.

The history of chemical industry is rich in examples of new processes in which the established commercial success was achieved among the ruins of discarded doubts and scepticisms at the outset. Hydrogenation is a long-tried process; it has, as a technical procedure, been brought to a high state of efficiency. It is chemical engineering at its best. Oil production from coal, whether by this or by any other means is, and must inevitably be, on whatever scale achieved, a product of chemical industry. To this extent, the product differs fundamentally from anything realised by the petroleum industry.

The coal industry *per se* is non-existent in the same sense in which we contemplate and assess the activities of the oil industry to-day. It discarded individuality long ago in favour of second-hand recognition through the medium of dependent products such as gas, coal-tar, dyes and allied substances, the enormous developments of which not only built up relevant commercial activities, but also have contributed more to the growth of chemical industry as a whole than probably any other branch of it. Hydrogenated coal-oil when it arrives as an accepted economic commodity will simply add another weapon to the already powerful array of forces which chemistry commands in the sway of modern civilisation.

The moral to the petroleum industry in general, and to the technology in particular, is surely obvious. There has for long been the broadest possible overlap between research within the petroleum and chemical industries, at least as technically interpreted, and where basic substances common to both have been involved. Research, temporarily retarded as it may have been by prevalent conditions, has none the less forged ahead in chemical industry, as keenly animated as ever by the desire to conquer fresh fields and produce new outlets for natural resources at the present time only partially or extravagantly exploited. The trend of petroleum technology, if it is to compete with the incidence of an independent and biased chemical industry, must, apart from the actual winning of oil, inevitably lead in the direction of finding new and extended uses for its raw material and basic products.

It is insufficient to point to a succession of highly refined products of crude oil such as petroleum, paraffin, lubricating and fuel oils, wax and asphaltic bitumen—the high standard of production of which to-day is freely acknowledged —as though these represent monuments to final achievement. There can be no such finality, and research must aim far beyond the mere improvement of technique of production, the multiplicity of types and qualities of distillates, and the goal of supplying markets with what they have been accustomed.

In point of fact, the domain of petroleum technology is no longer inviolable; and if it does not of its own initiative expand actively into the realm of chemical industry, then assuredly will the latter gradually stretch the tide-mark of overlap until the merger is complete.

Petroleum, like coal, is a wasting asset. It is no longer the prerogative of the oil industry alone and, as a natural resource still possessing immense latent possibilities of more efficient development, it must come into line with other basic raw materials and be subject to that vigorous independent investigation which is afforded by intensive chemical research. Only in this way will it avoid some of the calamitous happenings which have led to the acute problems of efficient coal exploitation and utilisation, for which, it is to be noted, chemical industry has gone a long way to find a practical and economic solution. H. B. M.

Age of Retirement in India

UNDER the title "The Fifty-five Year Rule", the November issue of the Indian monthly, *Current Science*, contains a long leading article advocating the abolition of retirement from educational posts at the age of fifty-five, as is now compulsory under the fundamental rules, and the raising of the age limit to sixty years in the first instance, or making such appointments for life. We have read the article with some surprise, since we are convinced that the concensus of opinion of those engaged in educational work in Great Britain regards the comparatively recent introduction of the Universities' Superannuation Scheme with its corollary, a compulsory age of retirement, as a distinct contribution both to the efficiency of the universities and of the schools.

Although it is not uncommon for men of mature age to make valuable direct contributions to knowledge, there is no doubt that with increasing years their teaching, whether it be in the school class room or the university lecture theatre, tends to become stereotyped and lacking in inspiration. Furthermore, they show less and less inclination to initiate young students into the methods of research, although they themselves may continue to be actively engaged therein. A not unimportant feature of the superannuation scheme has been to accelerate the promotion of the younger men and so stimulate employment. So far as we can gather, the main objection to compulsory retirement is that it deprives the university of the services of men of mature experience, but we doubt if this is actually so in practice. It is now almost invariably the custom to confer upon the retiring professor the title of emeritus, which is recognised as carrying with it the right to laboratory accommodation in his old department, a privilege of which advantage is frequently taken.

The writer of the article in *Current Science* appears to be under the impression that professorships in European universities are life appointments. As a matter of fact, there remain a few professorships in Scottish Universities and at Oxford and Cambridge where a definite age of retirement has not been assigned, but as these fall vacant the general practice of retirement at sixty is being adopted. It is true that the German universities do not fix a date for retirement, but in that country a professor's pension is the same as his salary, and consequently there is not the same temptation as there is in Great Britain and in India to continue in office after effective service can be rendered.

It is suggested in the article that, as the result of the great advances made in preventive medicine, retirement at the early age of fifty-five is no longer necessary in India. Whilst the increased security of life in the East might be used as an argument for raising the retiring age to sixty, we doubt whether this is actually the case. Climate cannot be altered. The Indian matures much earlier than the European and he ages correspondingly earlier, so that as a general rule the present retiring age seems to be comparable to that prescribed in England.

It is pointed out in the article that though the Government has decided to terminate the services of professors and others in the educational service at fifty-five years of age, this is not the practice in the judiciary or administrative posts of cabinet rank. Though this suggests unjust inequality of treatment, we think the conditions are different in the two groups. One of the main essentials for success in education is originality, a gift more common in youth than in age; this qualification is scarcely required on the Bench. In the field of higher administration we note a growing tendency to find room for the younger men, and we think this is likely to increase in the future.

While we agree with the view expressed in the article that a man is not necessarily disqualified physically or mentally for further useful service in India when he reaches the age of fifty-five, we believe it is not usually desirable for Europeans to remain at work in that country beyond that age. If, however, a university finds it to the advantage of a department to retain a teacher after the age of fifty-five, a man who is still active at that age ought to be able to expect to have his period of service extended to the age of sixty. It is the practice in some educational institutions to make these extensions by one year at a time, and we suggest that if the universities could extend the services by such a period, not exceeding five years in all, after considering the merits of each case, there could be little cause of complaint.

Evolution and Mechanism of Hearing

Hearing in Man and Animals. By R. T. Beatty. Pp. xi+227. (London: G. Bell and Sons, Ltd., 1932.) 12*s*. net.

THE study of the evolution of the sense-organs has a fascination for the general reader as well as the scientific worker. Our knowledge of the world around us is dependent on the reaction between various forms of physical energy and the appropriate sense organs. Some of the latter, such as touch, smell, taste and sight, are common to all vertebrates and are found in much lower forms of life, but hearing is relatively uncommon and may be regarded as a 'recent' development. In many of the lower forms of life, for example, in insects and fishes, the sense of hearing is either entirely absent or exists in a most rudimentary form.

For its proper understanding, audition requires a knowledge of anatomy, physiology, physics and psychology. Specialists working in one or other of these sciences clearly have difficulty in following developments in the others. This tendency has resulted in the accumulation of a large mass of detailed and highly specialised information which is not easily accessible or intelligible to workers in a different scientific branch of the subject. The need has long been felt that such information should be collected and correlated.

The first important step to this end was made by the Physical Society in its published discussions on "Audition" and "Vision". In these publications the work of physiologists, physicists and psychologists is collected under the same cover. But this is not sufficient. A further important step is still required, namely, to present the collected data in the form of a connected whole, written in a language which all can understand. This work has been carried out in a remarkably efficient manner by Dr. R. T. Beatty in the work under notice. Here one may read for the first time, in clearly expressed terms, a coherent description of fascinating researches in widely different fields of science.

In the preface, the purpose of the book is stated "to convey in plain terms to the general reader a connected account of the phenomena of audition in living creatures, and of the various mechanisms by which animals are made sensitive to the range of sounds which is important for their welfare". Dr. Beatty has fulfilled his purpose in a very satisfactory manner. The literary style is delightful and the information contained in the book will be satisfying and instructive not only to the general reader, to whom it is primarily addressed, but also to a wide range of scientific workers, teachers and research workers. The two-page list of acknowledgments at the beginning of the book is in itself interesting, indicating as it does the wide field over which the author has collected his material. This is further supported by the comprehensive list of references at the end of each chapter of the book.

The opening chapter gives a detailed description of the human ear and the functions of the various parts. The function of the chain of ossicles in the middle ear is particularly interesting as it involves a principle frequently occurring in technical acoustics. The flexible diaphragm, the ear drum, receives sound energy from the surrounding air and transmits it to the liquid-filled cochlea. The efficient transmission of this energy from a relatively light and yielding medium to a heavy, resistant fluid, requires the intermediary of a mechanical transformer, a lever, having the correct lever ratio. This is provided by the chain of bones.

One of the most fascinating chapters of the book is that which describes the evolution of the ear. Commencing with the primitive auditory mechanisms in fishes, evolutionary growth is traced through amphibians, reptiles and birds, to mammals. A later chapter of equal interest deals particularly with hearing in animals. These chapters abound with new and interesting information. For example, the ears of insects are never found on the head. The external ear, which takes the form of a stretched membrane covering an opening in the exterior shell of the insect, may be placed in some cases on the thorax, or the abdomen, or, as in grasshoppers and crickets, just below the knee-joint of the forelegs. Cases are recorded in which the external hairs of insects play a part in the reception of sound, and certain types of caterpillar respond to the human voice by suddenly raising the front part of the body.

Dr. Beatty explodes a few time-honoured beliefs. Fishermen should note, in spite of Isaac Walton's statements to the contrary, that fish cannot hear air-borne sounds. The angler is at last released from bondage and he may now converse freely whilst plying his rod. The sounds produced by his boots, knocking against the hull of the boat or tramping on the river bank, are on the contrary conveyed readily to the fish's auditory apparatus with disastrous results to the catch! It is a little disappointing to learn that snakes are deaf to air-borne sounds and that the piping of the snake charmer charms only the audience. Dogs, on the other hand, are extremely sensitive to sounds. Pavlov's experiments indicate that they have a sense of absolute pitch which considerably surpasses that of human beings. Furthermore, their frequency range of audibility is much greater, extending from very low sub-audible (that is, to human ears) to supersonic frequencies. Experiments reveal also that they can readily discriminate between the pitch of two tones only a quarter of a semi-tone apart. Such remarkable observations on the dog's auditory apparatus have led to the suggestion that hearing in man is on the downward grade, not due to imperfection in the ear, but from defect of nerve connexions in the brain. "We must remember that man stands alone in the animal kingdom in his power to interpret speech, and that large cortical areas have been given over for that purpose, no doubt at the expense of the perception of subtle variations in pitch and rhythm which is so clearly manifest in the case of the dog".

A short but interesting chapter deals with the happenings in the human brain when the nerve endings in the cochlea are stimulated by an external sound. The nerve impulse is relayed from one station to another until it reaches the 'conscious' part of the brain. These relay stations not only pass on information to the brain but also inform other nerve centres which control the automatic reflex movements of the eye and other parts of the body. At its maximum sensitiveness, the ear can respond to a sound intensity of 10^{-9} microwatt per square centimetre, a quantity of the same magnitude as light from a candle at a distance of eight miles, assuming perfectly transparent air. The ear is a more efficient receptor than the eye.

Two chapters are devoted to the study of theories of hearing. Although the resonance theory holds the field, there are still many discrepancies in detail which require further investigation. Interesting experiments on animals are described in which degeneration of certain parts of the organ of Corti over a limited region is produced by a long-continued tone. Pavlov's experiments on dogs and Held's work on guinea pigs show that surgical operations in which a small portion of the cochlea is destroyed, result in localised deafness the frequency range of which depends on the point of operation.

The book concludes with three interesting chapters on music, noise and defects of hearing. The chapter on music, dealing as it does with origins, in respect of style and subject matter, would form a fitting chapter in Wells's "Outline of History". The treatment of noise is essentially modern, bringing the reader into touch with the special problems of civilisation, with its roar of machinery and traffic. The effects of noise on working power and on the nervous system are examined critically, and an estimate is made of the 'cost' of noise. The final chapter on defects of hearing appropriately follows the chapter on noise.

Dr. Beatty deserves unqualified congratulation on his success in producing this excellent book on hearing. It is well written, well illustrated and well reproduced. Readers will look forward to a companion volume on "Sight in Man and Animals".

The Spiders of Denmark

The Biology of Spiders: with Especial Reference to the Danish Fauna. By E. Nielsen. Vol. 1. Pp. 248 + 32 plates. Vol. 2. Pp. 724 + 5 plates. (Copenhagen: Levin and Munksgaard; London: Williams and Norgate, Ltd., 1932.) 30*s*.

THIS substantial work is a record of observations of the habits of Danish spiders, and appears in a somewhat unusual form. The full accounts are contained in the second volume, written in Danish and fully illustrated; the first volume is a slightly condensed translation, almost without illustrations save for a collection of plates at the end. Thus the first volume forms an English guide to the second. The Danish preface is dated May 1, 1928, and the English preface September 1, 1931, so that the first volume includes some recent observations not contained in the second. On the other hand, the very complete Danish account of the structure of spiders is omitted from the English volume.

Part I of this work is a general account of the life history of spiders; Part II records the author's observations on the individual species, arranged according to Simon's classification. It is unfortunate that the book was written just too soon to adopt the system contained in Prof. Petrunkevitch's "Systema Aranearum", as it may lead to a tendency to perpetuate Simon's now obsolescent method.

The observations consist chiefly in descriptions of the webs, the cocoons, and the feeding and mating habits. It would not be possible to study spiders as long and as carefully as Mr. Nielsen has done without breaking new ground, and there is much that is new in this work. The most striking is undoubtedly the careful account of the separate functions of the claws and tufts of 'hair' on a spider's foot as it grasps a silk thread or runs over a web. The author describes how the set of the claws gives a twist to the thread, and how the hair-tuft forms a springy pad which detaches the claw as the spider runs—a very careful analysis of a process which is unexpectedly elaborate. A large section of the work, Part III, deals with the parasites of spiders. Mr. Nielsen writes of these with the authority of a specialist, and this account of his work is extremely welcome. Other features which will be of interest to English readers are his descriptions of the triangle-spider, *Hyptiotes*, and the water-spider, *Argyroneta*, of the burrowing wolf-spiders, and of the temporary egg-teeth on the palpi of *Zilla*, which help the young to burst the egg-membrane.

The author is a skilled photographer and the work contains more than four hundred reproductions of his work of quite outstanding merit. Photographs of spiders are never easy to obtain and there is no other book known to us in which the photographs approach the excellence of those used to illustrate these volumes.

Mr. Nielsen is content to describe what he has seen, and his book would more accurately be described as a natural history than a biology. There is very little discussion of the general significance or broader aspects of the facts observed, save for some careful analyses of various cocoons. Indeed a blemish on the work is the naive way in which the author endows spiders with mental attributes. He describes a female *Agelena* as "very affectionate", and says that young wolf-spiders can cling to their mother's back, "being from birth acquainted with the laws of inertia".

The second volume ends with a list of Danish spiders, and a supplement to this in the first volume brings the total to 372 species. About four-fifths of these are also British. This is a valuable addition to the book, and makes Denmark more fortunate than England, for no list of British spiders has appeared for more than thirty years. Both the author and his publishers may thus be congratulated on the production of a most acceptable book. T. H. S.

Diphtheria

Diphtheria, Past and Present: its Ætiology, Distribution, Transmission and Prevention. By Dr. J. Graham Forbes. Pp. xx + 832. (London: John Bale, Sons, and Danielsson, Ltd., 1932.) 45*s*. net.

DIPHTHERIA is one of the best understood human bacterial diseases and its study has enriched bacteriology with several ideas of prime importance. The isolation of the bacillus by Loeffler (1884) provided a means of precise diagnosis: the discovery of antitoxin by Behring (1890) opened up an entirely new field in prevention and therapy. Theobald Smith (1907) saw the possibility of making people immune by the inoculation of toxin: Schick (1908) made this practicable by devising his simple test for individual immunity. Diphtheria is also the disease in which it was first shown that the lesions could be produced by toxin without the bacilli and in which the possibility of becoming immune by subinfection without any actual illness was first clearly recognised.

Pathologist, bacteriologist and hygienist therefore all know a great deal about the diphtheria bacillus and what it does, which is set out in the monograph published by the Medical Research Council in 1923. Since almost anyone can be deliberately immunised (nowadays with toxoid-antitoxin mixtures) and scarcely any patients will die if they are given antitoxin at the outset, it seems that the disease might well be abolished altogether if practical hygiene and medicine were a sufficiently accurate reflection of bacteriological knowledge. In fact, children still catch diphtheria and a proportion of them still die of it, and Dr. Forbes's book consists of a very detailed account of the occurrence of the disease, what has been done in the way of prevention and what we may hope to achieve in the future. It seems clear from his account that the failure to get rid of diphtheria is due almost entirely to difficulties in practical application rather than to imperfections in knowledge.

The book is a voluminous expansion of the Milroy Lectures of 1929 and consists almost wholly of facts and figures; we could wish that Dr. Forbes had not been so sparing of commentary. It is, however, cheering to find that the intensive campaign of immunisation started by Park in New York in 1913 is at last having an effect on the diphtheria death-rate sufficient to satisfy the statisticians—"unfeeling men" as the late Sir Frederick Andrewes calls them in his preface.

Surface Catalysis

Von Davy und Döbereiner bis Deacon: ein halbes Jahrhundert Grenzflächenkatalyse. Von A. Mittasch und E. Theis. Pp. 278 + 16 Tafeln. (Berlin: Verlag Chemie G.m.b.H., 1932.) 18.50 gold marks.

DRS. MITTASCH AND THEIS have provided a charming record of work on surface catalysis during a period of half a century from Davy and Döbereiner to Deacon, and have dedicated it to Wilhelm Ostwald. The book is illustrated by portraits of the three workers whose names appear in the title and of twelve of their contemporaries, together with a more recent portrait of Prof. Horstmann, who died at Heidelberg in 1929. The narrative is also illustrated with some fourteen diagrams, including a series of Döbereiner lamps and allied devices for ignition with the help of spongy platinum or the like.

The scope of the work has been restricted by excluding the modern developments which have brought surface catalysis to the forefront as an industrial method of first-rate importance, and by omitting the important subject of homogeneous catalysis. The latter is referred to briefly in a "Review of Related and Separated Fields" (Chap. xiv) as well as in the final "Retrospect and Prospect" (Chap. xv). In this final chapter it is pointed out that a lull in the study of heterogeneous catalysis between 1875 and 1890 was followed by an intensive study of homogeneous catalysis; this preceded the great modern applications of surface catalysis, the foundations of which form the subject of the present monograph.

One of the earliest of these foundations was Davy's 'night lamp' (1818); in this lamp a platinum spiral was maintained in incandescence over the wick of a spirit lamp, of which the flame had been blown out. Döbereiner's discovery of the oxidation of alcohol to acetic acid by platinum black followed in 1831; and the ignition of oxyhydrogen mixtures, leading to the development of the Döbereiner lamp, in 1832. The term 'catalysis' was introduced by Berzelius in 1835, and was followed by a controversy with Liebig as to the nature of 'catalytic force'.

The application of catalysis to the preparation of sulphuric acid by the 'contact process' can be traced back to an English patent taken out in 1831 by Phillips, who proposed to use platinum for this purpose, whilst Robb in 1853 introduced the use of 'peroxide of iron'. In the same way, the catalytic oxidation of ammonia to nitric acid can be traced back to the work of Kuhlmann, who discovered in 1838 that nitric acid was formed when air and ammonia were passed over platinum heated to about 300°.

The early period in the history of surface catalysis closes with the technical development of Deacon's process for making chlorine by the catalytic oxidation of hydrogen chloride. This method can be traced back to the work of W. Henry in 1826, but was only developed into a practical process about 1870. The technical conditions in this case were not too difficult, since there was no need for the drastic purification by which alone success was finally achieved in the contact process for sulphuric acid; and the high temperatures and pressures which are required for the synthesis of ammonia, and for many other processes of catalytic hydrogenation, were also not yet needed. There was therefore a natural sequence in the industrial development of surface catalysis, and the authors are to be congratulated on the success with which they have brought out the logical character of this important chapter of chemical history.

Short Reviews

Traité de pyrométrie optique. Par Prof. Gustave Ribaud. (Encyclopédie photométrique, Cinquième section, Mesures sur l'émission, Tome 4.) Pp. xvi + 485. (Paris: Editions de la *Revue d'Optique théorique et instrumentale,* 1931.) 95 francs.

It is a remarkable sign of the progress of theoretical and experimental knowledge in a single branch of physics that a volume of nearly 500 closely printed pages should be required to give an account of modern optical pyrometry. In an interesting preface, M. Charles Fabry points out that the production of high temperatures in industrial and laboratory operations outstripped for a long period the methods of measuring such temperatures. For example, the gas thermometer, theoretically the simplest form, failed because no reservoir could be found which would retain its shape and remain absolutely impervious to gas at extremely high temperatures. The problem of measuring these temperatures was only effectively solved when the use of a material thermometer was abandoned and attention was concentrated on the radiation emitted by the body the temperature of which was to be found.

All the methods based on the examination of the associated radiation may be included under the name optical pyrometry. These methods are based on the laws of radiation of a black body due to Stefan, Wien, and Planck—laws which are discussed by Prof. Ribaud in the earlier part of the volume. The most valuable method is that of the disappearing filament optical pyrometer. The importance of this instrument is illustrated by its use in determining the temperature of tungsten lamps for an intercomparison of the high temperature scales of the leading standardising laboratories. For any point of the entire range from about 1,400° to 2,700° K. the maximum difference found in such an intercomparison was only a few degrees (W. E. Forsythe). Prof. Ribaud's book should be in the hands of all those who are concerned with high temperature measurements. H. S. A.

Prout's Hypothesis. Papers by Dr. William Prout (1815–16), J. S. Stas (1860) and C. Marignac (1860). (Alembic Club Reprints, No. 20.) Pp. 58. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson, 1932.) 2*s*. 6*d*. net.

SOON after the classification of the chemical elements by Lavoisier, and the decomposition of the alkalis by Davy, the latter, in 1812, suggested that the "undecompounded substances" may be composed of hydrogen "with another principle yet unknown in the separate form". If we identify this principle with the electron, we have in this speculation (not mentioned in the present Alembic Club Reprint) an anticipation of the modern theory of atomic structure as striking as the prediction of isotopes by Crookes in 1886, and of the packing effect by Marignac in 1860. The logical development of Davy's idea was found in the papers of Prout (1815–1816), which are reprinted in the present volume, suggesting that atomic weights are whole multiples of that of hydrogen, and that "we may almost consider the πρώτη ὕλη of the ancients to be realised in hydrogen".

Stas's criticism of Prout's hypothesis (1860), on the basis of exact atomic weight determinations, leading him to the conclusion that it is "nothing but an illusion, a pure hypothesis contradicted by experiment", follows. The thoughtful commentary on Stas's paper by Marignac (1860), in which it is suggested that "while preserving the fundamental principle of . . . the hypothesis of the unity of matter", we might "suppose that the cause which has determined certain groupings of the atoms of the sole primordial substance" may have exercised an influence such that "the weight of each group might not be exactly the sum of the weights of the primordial atoms composing it", was entirely disregarded.

The further progress of the matter is very ably summarised in a historical introduction to the booklet, which is one of great interest and fully maintains the high standard of the Alembic Club Reprints.

The Standard Natural History: from Amœba to Man. Contributors: G. J. Arrow, M. Burton, Dr. W. T. Calman, J. G. Dollman, Dr. F. W. Edwards, C. C. A. Monro, J. R. Norman, H. W. Parker, W. P. Pycraft, N. D. Riley, G. C. Robson, Theodore H. Savory. Edited by W. P. Pycraft. Pp. xiv + 942 + 12 plates. (London and New York: Frederick Warne and Co., Ltd., 1931.) 15*s*. net.

IT is somewhat of a venture to compress a knowledge of the animal kingdom, with its three-quarters of a million species, into a single volume, and preserve at the same time a balance between the different groups. But here the attempt has been successfully made, the more obscure groups receiving due place, the more familiar groups, such as birds and mammals, properly being singled out for relatively more expansive treatment.

The systematic cast of the book gives a false impression of its contents, for bare description has been reduced to a minimum and living interest has been sustained by the accounts of habits and of the links between structure and environment; the section on Diptera is a fine example of condensed biological survey. In most of the sections there is a freshness of treatment traceable to the specialised knowledge of the contributors and among the 900 odd illustrations we are grateful for a great many new figures, although several of the pictures of mammals and birds, from indifferent museum specimens, might have been bettered.

Bentham's Theory of Fictions. By C. K. Ogden. (International Library of Psychology, Philosophy and Scientific Method.) Pp. clii + 161 + 3 plates. (London: Kegan Paul and Co., Ltd., 1932.) 12*s*. 6*d*. net.

IN a public lecture recently given in London, Prof. Schlick, of Vienna, said that if philosophers had given more consideration to linguistics, the history of our civilisation would have been different. Indeed, it seems that only a realistic analysis of language could purify philosophy and the special sciences of much of their misleading verbiage. The modern schools of mathematical logicians have done useful work in this direction. Yet the developments of the present should not make us forget the attempts of the past. A thorough study of Bentham's "Theory of Fictions" will prove it to be a mine of information and suggestions. Mr. Ogden has done a real service to philosophy by publishing this book, which will be considered by many as a revelation and as a valuable basis for further research. The actual interest of Bentham's "Theory of Fictions" is enhanced by Mr. Ogden's very able introduction. T. G.

The Spirit of Language in Civilization. By Karl Vossler. Translated by Oscar Oeser. (International Library of Psychology, Philosophy and Scientific Method.) Pp. vii + 247. (London: Kegan Paul and Co., Ltd., 1932.) 12*s*. 6*d*. net.

LANGUAGE is viewed at an unusual angle in this work, which describes the interweaving of language with the other activities of mind. It is the philosophy rather than the analysis of language it presents. The author has striking conclusions to put forward on a variety of subjects such as "Language and Life", "Language and Nature", "Language and Science", "Language and Poetry", "Language and Religion". To quote but one of them, he thinks that mathematics might be called a language which allows only pronouns in place of nouns, imperatives in place of verbs, copulative equations instead of adjectives and adverbs. The purpose of mathematical co-ordination of language and concept is the liberation of the concept from the senses. But there is danger in an extreme liberation, because too much reason and abstraction scarcely allow thought to find the way back to itself.

Edmond Halley[*]

By Dr. Allan Ferguson

THE contributions of Shoreditch to the advancement of science are neither many nor varied; the occasional visitor to that cabinet-making region is usually drawn thither by the fame of the parish stocks and whipping-post, or of that oddly inscribed tombstone which marks Dr. John Gardner's "last and best bedroom". But the district has made one contribution of primary importance, for it was in the parish of St. Leonard's Shoreditch that Edmond Halley was born in 1656. Shoreditch was then a suburb of that pre-fire London of which so few traces remain. The London that Halley knew was a London cheerful, noisy and dirty, to modern eyes incredibly small, with narrow, fetid, kerbless streets and rat-ridden, overhanging houses; with a steep descent to the Fleet river, then practically an open sewer, where Holborn viaduct now stands; with an equally steep ascent to Tyburn along that *via dolorosa*, now called Oxford Street; with one ancient many-arched bridge joining the city to Southwark, its gateway crowned with frowning and blackened heads, its piers and starlings damming the river so effectively as to produce at certain stages of the tide several feet difference of level in the water above and below the bridge; with Whitehall still crossed by a Tudor gateway, and the banqueting house of Inigo Jones alive with recent memories of the royal execution.

The ghastly plague pit at Aldgate, hard by the Three Nuns hotel, comes clearly enough even now before the minds of those who turn eastwards from Houndsditch along the little alley that skirts St. Botolph's church, and swings southward through Church Row to join Aldgate. A Three Nuns' hostel still stands near the church, the graveyard of which is significantly raised some feet above the level of the surrounding streets. Pit, inn, church, and the vanished Pye Tavern "over against the end of Houndsditch" where an obscene crowd of roysterers was wont to gather and to jeer at the passing dead-cart must have been very vivid in the memory of Halley, who passed, apparently unscathed, through these fateful years. He was educated at St. Paul's School, under Dr. Thomas Gale, and at fifteen years of age was captain of the school. In 1673 he was admitted a student of Queen's College, Oxford, "having already acquired not only good skill in the Latin, Greek and Hebrew Tongues, but being also well acquainted in the Principles of Geometry and Astronomy, in which he . . . so early distinguisht himself, that we find a Piece of His, called, *Methodus directa et Geometrica cujus ope investigantur Aphelia, Excentricitantes, Proportionesque Orbitarum Planetareorum, absque supposita æqualitate Anguli motus ad alterum Ellipeos Focum, ab Astronomis hactenus usurpata*, . . . publish't in the *Philosophical Transactions* for the Months of August and September, 1676." Kepler had, as we know, enunciated many years before this date his laws stating that the path of a planet is an ellipse, with the sun in one focus; and that the motion of the planet round the sun is not uniform, but is such that the line joining sun to planet sweeps out equal areas in equal times. It was assumed, and it is in fact nearly true, that the motion about the empty focus of the ellipse was exactly uniform; that Halley, at nineteen, should be able to attack critically such a problem shows that he was already highly skilled in the use of the imperfect mathematical apparatus of his day.

Halley did not stay long enough at Oxford to take his degree. His was one of those prescient characters that realises almost instinctively the direction in which knowledge is advancing, and which field it profits best to cultivate. His tastes lay in the direction of astronomy, and he well knew that trustworthy star-charts were one of the pressing needs of the day. But several explorers, Flamsteed and Hevelius in particular, had already set out to chart the northern stars, and Halley, now a skilled mathematician and observer, knew the advantages of a clear field; he therefore decided to make a beginning in the southern hemisphere.

Halley's father, a wealthy London tradesman, settled on his son an allowance of £300 a year, and in 1676, armed with "an excellent brass sextant of 5½ feet radius, with Telescopic Sights and indented Semicircles of the same Metal, and Screws for the ready bringing it into any Plane; a Quadrant of about 2 foot Radius, which he chiefly intended for observations to adjust his Clock; a good pendulum clock; and a Telescope of 24 feet; some lesser ones; and two Micrometers", Halley set sail for St. Helena, where he had decided to set up his observatory.

The climate of St. Helena proved to be very much what it was a century and a half later when the island became the scene of Napoleon's exile. Nevertheless, though the skies were cloudy and rain frequent, Halley stayed there for about a year; and the title of the 'Southern Tycho' was given to him in virtue of his star catalogue, published in 1679.

In this last-named year, Halley embarked upon another adventure. To-day it appears absurdly obvious that far greater accuracy in determining stellar positions is obtained by sighting a star through a telescope than by using the naked eye and the sighting rods in the manner of the older astronomers. This was not so obvious in 1679; ordinary pinhole sights were certainly crude, but Tycho, one of the great pioneers in exact measurement, had improved this type of sight almost beyond recognition. An example of his measurements may serve to show the accuracy attainable by the use of naked eyesights. Tycho, alive to the necessity for accurate charting, selected seven stars, the most important of these being α Arietis, as standard stars, the positions of which on the celestial sphere he determined with the highest possible accuracy. These measurements of position must, of course, be made with reference to some definite starting point, and it is the intersection of the sun's apparent yearly path in the heavens with the equator of the celestial sphere which determines the position of the Greenwich of the heavens. Tycho's task, therefore, was that of linking up the position of the sun with that of any one of the selected stars. This was done by means of an intermediary, Venus, visible both in the daytime and at night. Tycho determined the relative positions of the sun and Venus, and afterwards of Venus and one of the selected stars, making due allowance for the motion of Venus in the period intervening between the two observations. Some notion of Tycho's accuracy may be gleaned from the fact that the Right Ascension (the analogue of terrestrial longitude) of α Arietis was fixed by him at a mean value of 26° 0′ 30″, the modern estimate for the year 1585 being 26° 0′ 45″. Dreyer gives the probable errors of the positions of Tycho's standard stars as ± 24″·1 in Right Ascension and 25″·9 in Declination (when corrected for refraction).

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[*] "Correspondence and Papers of Edmond Halley." Preceded by an unpublished Memoir of his Life by one of his Contemporaries, and the 'Éloge' by d'Ortous de Mairan. Arranged and Edited by Eugene Fairfield MacPike. (History of Science Society Publications, New Series 2.) Pp. xiv+300+9 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1932.) 21*s*. net.

With possibilities of consistency in observing indicated by figures such as these, it is not surprising that older observers, cognisant of the crudity of the new telescopic sights, should elect to continue to make their observations by the older methods. Foremost among them was Hevelius of Dantzig and, the better to make a critical comparison of the two methods, Halley visited Dantzig in 1679. He was duly impressed with the skill displayed by Hevelius in the use of his instruments, and, in a letter to Flamsteed under date June 7, 1679, he says, after describing the equipment of Hevelius's observatory:—"... As to the distances measured by the Sextans, I assure you I was surpris'd to see so near an agreement in them, and had I not seen, I could scarce have credited the relation of any; Verily I have seen the same distance repeated several times without any fallacy agree to 10″, and on Wednesday last I myself tryed what I could doe, and first I at the moveable sight, and the Printer at the fixt did observe the distance of Yed Ophiuchi from Lucida Aquilæ 55°-19′-00″; then we removed the Index, and my Lord at the moveable sight and I at the fixt did observe the same 55°-19′-05″, and you will find the same distance 6 times observed in Page 272 of ye fourth book of his Machina Coelestis, so that I dare no more doubt of his veracitye." Nevertheless, Halley was too sagacious not to realise that ultimate victory lay with the users of telescopic sights. As for Hevelius, the writer of a memoir of Halley remarks that "the old Gentleman was too much rivetted to his Opinion of those he had so long and so successfully used; and had besides been too much sour'd by the manner in which Dr. Hooke had too freely treated his Labours to think of altering his method or opinion".

It is interesting to note that in a hitherto unpublished letter in the Royal Society's archives Halley, writing under date 1686 to Molyneux concerning "the state of the Controversy between Mr. Hevelius and Mr. Hook about Telescope Sights wherein I am so much concerned", remarks that this controversy "does, as Hevelius manages the matter, affect all those observers that use Telescope sights, and myself in particular, and it is our common concern to vindicate the truth from the aspersions of an old peevish gentleman, who would not have it believed that it is possible to do better than he has done".

Halley's next piece of sustained practical work lay in a study of the variation of the compass. Here again we see illustrated his habit of seizing on a pioneer piece of work, and rounding it off neatly and thoroughly. Provided with a vessel, the *Paramour Pink*—did ever other astronomer sail in so romantically named a ship?—Halley set sail in 1698. True to her romantic name, the ship was the scene of a mutiny, and Halley was forced to return to England. A mutinous lieutenant duly cashiered, Halley again set sail, this time accompanied by a consort, and returned the possessor of a unique mass of data, which he exhibited graphically after the modern manner, being in this matter again a pioneer.

Halley was appointed Savilian professor at Oxford in 1703, and in 1719, promoted to the position of Astronomer Royal, this indefatigable worker found himself in command of an observatory almost unprovided with instruments. He refurnished the observatory and optimistically set out at the age of sixty-three on an eighteen year cycle of lunar observations. He was, as ever, fortunate in his plan which he lived to complete, dying at the patriarchal age of eighty-five years. His interest in cometary orbits led him to study in detail the paths of several of these bodies and he concluded that the comets seen in 1531, 1607, and 1682 were not three separate bodies, but one and the same. The matter is, of course, considerably more complex than is indicated by a mere comparison of periods. Halley had, with immense labour, worked out the elements of the orbits of twenty-four comets. Three of these—those just mentioned—were sufficiently similar to make their identity probable, and this possibility was strengthened by the records of cometary appearances in 1305, 1380, and 1456. Nevertheless, the variations in the periods, and the differences in the inclinations of the orbits, amounting to as much as a degree, made recognition of their identity by no means certain. Halley was, however, too good a

Newtonian not to recognise that irregularities might be introduced by the gravitational pull of the giant Jupiter and, taking due cognisance of this, he ventured on his prophecy. "*Quo-circa,*" says he, "*si secundum predicta nostra redierit iterum circa annum 1758, hoc primum ab homine Anglo inventum fuisse non inficiabitur acqua posteritas.*" This prediction of its return in 1758, and its reappearance on Christmas Day of that year, near upon twenty years after Halley has been laid to rest in Lee Churchyard, is one of the dramas of the eighteenth century.

Halley, too, first showed from a comparison of ancient and modern observations that Aldebaran, Arcturus and Sirius had 'proper motions'.

Remarkable, however, as may be the sum of these achievements, his place in the history of the development of astronomical science depends largely on his friendship with Newton and on his connexion with the Royal Society. He was elected a member of that body in 1678, and in 1685, when one Mr. Aston resigned his position as secretary in something of a passion, the Council, in order to avoid future contretemps, decided to appoint a paid clerk who "shall be a single man without children . . . shall be master of the English, French and Latin tongues, . . . shall be able to write a fair and legible hand, and shall be completely seen in the Mathematics and Experimental Philosophy". His duties were carefully defined, and his emoluments fixed at £50 per annum at least, with a lodging in "the College where the Society meeteth". Halley was appointed to the position after a contested election.

About this period the inverse square law of gravitation was in the minds of many astronomers. Kepler had laid the foundations in the statements that :—

(*a*) The planets move in ellipses having the sun in one focus ;

(*b*) The radius vector sweeps out equal areas in equal times ; and

(*c*) For different planets, the squares of the periodic times are proportional to the cubes of their distances from the sun.

It is not a very difficult matter to deduce the inverse square law from Kepler's third statement, and Hooke, Halley and Wren had each, apparently, accomplished this feat. But the inverse problem—given the law of force, what will be the path of a planet ?—proved too much for all of them. In a well-known letter from Halley to Newton we find the statement that "in January 1683–4 I, having from the consideration of the sesquialterate proportion of Kepler, concluded that the centripetal force decreased in the proportions of the squares of the distances reciprocally, came on Wednesday to town (from Islington), where I met with Sir Christopher Wren and Mr. Hooke and falling in discourse about it, Mr. Hooke affirmed that upon that principle all the laws of the celestial motions were to be demonstrated, and that he himself had done it". In the same letter he chronicles an offer made by Wren in a sporting spirit which we do not usually associate with his name. We read that "Sir Christopher, to encourage the enquiry said that he would give Mr. Hooke some two months' time to bring him a convincing demonstration thereof, and besides the honour, he of us that did it should have from him the present of a book of forty shillings. Mr. Hooke then said he had it, but that he would conceal it for some time, that others trying and failing might know how to value it when he should make it public. However, I remember that Sir Christopher was little satisfied that he could do it, and though Mr. Hooke then promised to show it him, I do not find that in that particular he has been so good as his word".

It was Halley who took the problem to Newton, to find that Newton had long ago solved this and other problems of planetary motion, and it was Halley's enthusiasm that overcame Newton's constitutional aversion to publication, and drove him to put forward his views in connected form. On April 28, 1686, Dr. Vincent laid before the Royal Society the MS. of the first book of the "Principia", and on May 19 the Society resolved that "Mr. Newton's *Philosophiæ Naturalis Principia Mathematica* be printed forthwith in quarto in a fair letter". On June 2 we hear a different note ; the Council orders that "Mr. Newton's book be printed, and that Mr. Halley undertake the business of looking after it and printing it at his own charge" ; and Halley undertakes the task.

The Society was, in fact, in financial straits. It had, some time before, published "Willoughby de Historia Piscium", doubtless a learned volume, and one which then excited as much attention as a similar volume would do to-day. The Society made desperate efforts to minimise its loss, and the phrase "books of fishes" recurs in the Council minutes of the period like "the owercome o' a sang". The salaries of their officers fell into arrears, and the Council resolved to pay the unlucky philosophers in "books of fishes". Halley was agreeable ; Hooke more cautiously desired six months time to consider the acceptance of such payment ! Again, when the Society asked Halley to undertake the measurement of a degree of longitude, it was resolved that he "be given £50, or fifty books of fishes".

Newton, who could on occasion show what in a lesser man would be called peevishness, did not make Halley's task any easier by desiring to suppress the MS. of the third book of the "Principia", on hearing that Hooke was putting forward claims to priority. But Halley's perseverance triumphed over all difficulties and on July 5, 1686, the book received the *Imprimatur* of the then president, Samuel Pepys ; it was published about the middle of 1687.

Such is, in bare outline, the history of Halley's share in the publication of the "Principia". Rigaud does not put it any too high when he writes of "the immense obligation which the world owes . . . to Halley, without whose great zeal, able management, unwearied patience, scientific attainments, and disinterested generosity, the *Principia* might never have been published".

The book before us does not call for detailed review. It is a model of its kind, and, while not a life of Halley, it brings together a mass of material which, interesting in itself, should prove of immense value to any future biographer of Halley. The volume contains a memoir, possibly written by Martin Folkes, an *éloge* by de Mairan, a chronological list of Halley's correspondence, and a large quantity of hitherto unprinted letters and papers arranged in order of date. An appendix of about a hundred pages is concerned with a valuable series of Halleiana. Scholarly, relatively inexpensive, and well produced, the book should find a place on the shelves of every serious student of astronomy.

Recent Radio Research

THE Department of Scientific and Industrial Research has recently issued the report of the Radio Research Board for the year 1931,* summarising work carried out during the year. The investigations described are concerned mainly with the fundamental study of the electrical state of the upper atmosphere and its influence on the propagation of radio waves of all frequencies; the principles and improvements of method of radio direction-finding; the study of atmospherics from the point of view of radio communications and meteorology; the development of radio frequency standards; and the improvement of electrical measurements at high frequencies. This work is carried out mainly at the Radio Research Station, Slough, and at the National Physical Laboratory, Teddington, but a certain amount of research has also been fostered at universities.

The study of the ionisation of the atmosphere and its influence on the propagation of radio waves has been continued both by the frequency-change method which was originated in Great Britain by Prof. E. V. Appleton, and also by the pulse-emission or group-retardation method, first developed by G. Breit and M. A. Tuve in the United States. To assist in this investigation, which includes the systematic collection of data on the electrical properties of the upper atmosphere, a special transmitting installation has been designed and is in course of construction at the National Physical Laboratory. Concurrently with the experimental work, a theoretical analysis is being made of the effect of the upper atmosphere on radio waves, and the mathematical formulæ are being evaluated numerically for typical cases, so that the results can be used by the practical radio engineer. In all this work the effect of the earth's magnetic field is being studied, the necessity for this having been confirmed in an interesting manner in the year under review by experiments carried out in the southern hemisphere under the Australian Radio Research Board.

The report describes also the extension of the study of wave propagation to wave-lengths of less than 10 metres. In the first instance, the transmission of these ultra-short waves along the earth's surface has been investigated, and from the resulting measurements, values of the effective conductivity and dielectric constant of the earth have been obtained by wave-lengths between 1·6 and 10 metres. In addition, experiments have been carried out on a wave-length of 5·5 metres over a distance of 44 miles. In these experiments the absence of any downcoming radiation from the upper atmosphere was clearly indicated, and it was apparent that only the direct or ground waves were effective in securing communication, although the reception obtained was definitely not confined to the rectilinear or so-called 'optical' path between transmitter and receiver. Certain diurnal variations were found on hot, sunny days which were not experienced on dull, autumn days. The theoretical and practical investigation of the whole subject is being continued. Progress is also recorded in the study of improved means for generating electron oscillations giving rise to wave-lengths of less than 1 metre.

The report indicates that considerable progress has been made towards the development of the perfect direction-finder for medium wave-lengths, free from errors caused by downcoming waves occurring mostly at night. The behaviour of direction-finders on shorter wave-lengths is being studied, and the application of the cathode ray oscillograph to a direct-reading instantaneous direction-finder has met with considerable success. This is undoubtedly due to the large amount of experience previously obtained in the use of these instruments in the study of atmospherics at the Radio Research Station.

In the present crowded state of the ether, it is specially important that every radio station should accurately maintain its allotted wave-length or frequency. The precise measurement of frequency, therefore, has become of great practical importance. The primary national standard of frequency is maintained at the National Physical Laboratory, and, as the report explains, is based on a tuning-fork maintained in continuous and steady vibration. The rate of vibration of the standard tuning-fork is now directly referred to that of an astronomical clock by an electrical arrangement, and can be obtained accurately to within one part in ten million. Experiments are in progress to determine the short-period constancy of the fork, that is, the constancy for one or two minutes at a time. It is not easy to compare frequencies to an accuracy of one part in a hundred million during an interval of only one minute, but such tests as have already been made indicate that the fluctuations due to the action of the thermal regulation are less than one part in a hundred million.

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* Department of Scientific and Industrial Research. Report of the Radio Research Board for the Year 1931. Pp. iv + 123. (London: H.M. Stationery Office, 1932.) 2*s*. net.

"Sufficient experience has now been accumulated," the report says, "to enable the statement to be made that properly designed and steadily operated tuning-forks form a primary frequency standard of reliability of about one part in ten million, a result fully equal to that of the best pendulum clocks. It is an interesting fact that the slight earthquake experienced in the south-east of England on June 7, 1931, caused a small change in rate of the pendulum clock of about four parts in ten million, which was revealed on the tuning-fork chronograph, the tuning-fork being unaffected by the shock."

It has now become necessary to develop apparatus to resolve the differences between the tuning-fork and the clock to enable short period fluctuations to be accurately observed. For this purpose radial vibrations of a small quartz crystal very carefully cut in the form of a ring are used to control the oscillation of a valve generator. The experiments carried out give good hope that a standard which is permanent and accurate to one part in a hundred million may be obtained in the near future.

The above review is by no means exhaustive of the contents of the report, which shows that the organisation controlled by the Radio Research Board continues the active pursuit of radio research and development, which in the past few years has placed Great Britain in a world-renowned position.

Obituary

PROF. JAMES JOHNSTONE

JAMES JOHNSTONE, the distinguished zoologist, oceanographer and philosopher, died at the age of sixty-two years at his home in Lochwinnoch on December 27 after a sudden attack of influenza. He appeared to have recovered from his former dangerous illness, so that his loss from an apparently accidental infection is felt the more keenly. He was not married.

There can be no doubt that he was a man of exceptional ability with an unusually wide knowledge of science; and a fearless and original thinker. Though reticent and even shy, "J. J.", as he was familiarly called, endeared himself to all those who had much to do with him by his kindly and sympathetic manner and his philosophical outlook on life's problems. It is characteristic of him that he was especially concerned about the future prospects of the junior staff and servants employed in his Department.

The future philosopher showed his naturalistic leanings as a boy when he roamed the country observing wild animals and collecting birds' eggs; he exhibited the urge of the 'vital impetus'—which was to concern him greatly later—when as a young man he 'emerged' from the environment of a journeyman wood-carver by attending evening classes at Lochwinnoch and at Glasgow. By the encouragement of his teacher and coach, Robert Logan, and the facilities afforded by the local school board and the Board of Education, he was enabled at the late age of twenty-five to begin the study of the biological sciences at the Royal College of Science, London, mainly under Prof. G. B. Howes. Before graduating in 1900 at the University of London he had already written one paper on the thymus in marsupials and two on fisheries subjects.

On his appointment in 1898 as fisheries assistant to Sir William (then Prof.) Herdman on the research staff of the Lancashire and Western Sea Fisheries Committee, Johnstone found a congenial environment; he threw himself with remarkable energy into studies in fisheries and the more general aspects of marine biology with such success that he had become a leading figure in British marine biology in 1908. This early success can be traced to his great interest in fisheries, to his unusually logical mind, and a great capacity for absorbing masses of data while perceiving and retaining a clear recollection of their interrelations, which he was able to expound in simple language. These faculties enabled him to bring together material on the growth and origin of "British Fisheries" (1905). The amassing of this material and his practical fishery experience placed him at once in a commanding position to give valuable support to the work of the newly instituted International Council for Fishery Investigations. The same faculties enabled him to produce an illuminating and classical work (1908) on "Conditions of Life in the Sea". This book was undoubtedly for many years a source of information and inspiration to the rising generation of marine biologists; in it he propounded a surprising proportion of the major problems which have been successfully investigated in recent years.

The basis of Johnstone's knowledge of fisheries lay in his experience in inshore and offshore work and the study of plankton in collaboration with his life-long friend, Andrew Scott. He also helped to lay the foundation for later successful work on the purification of shellfish. Marine bacteria were of great interest to him; his work led him to speculate on the existence in the sea of pathogenic types comparable with those found in terrestrial animals. He described a large number of malignant 'cancerous' tumours in fish, two of these being defined as of a "piscine tuberculosis" type, and accompanied these studies with extended investigations on parasites. His knowledge of this branch of pathology was associated with a vivid interest in human 'cancer', and its treatment by radium. Probably a real satisfaction in his life—betrayed in unguarded moments—was the success attending his share in the effort to procure radium for the Liverpool Radium Institute and Hospital for Cancer and Skin Diseases.

During the War, Johnstone's work on the dietetic value of fishes gained him an effective position on the Fish Preservation Committee of the Food Investigation Board of the Department of Scientific and Industrial Research.

In 1919, Johnstone was appointed lecturer in oceanography at the University of Liverpool and a year later he succeeded Sir William Herdman to the chair. In this new capacity he was fortunately able to indulge his leaning towards scholarship and philosophy. His works on oceanography brought up to date our knowledge of the physical features of the oceans; at the same time the story of the origin of the oceans is treated in a manner of fascinating interest to the students of geography and geology; "A Study of the Oceans" is indeed a new approach to the study of geography in a wide sense. Along with this work he undertook as director the reorganisation of the Port Erin Marine Biological Station and effected great improvements.

In later life the totality of the relations between things became to our savant—as to many other older scientific workers—of greater interest than lesser relations. He had already in 1914 surveyed the "Philosophy of Biology" and had stated the problems in his usual clear manner. These he elaborated later in "Mechanism of Life", and made what proved to be a final contribution recently in "Essentials of Biology" (1932). Here the fundamental problems of biology are discussed simply and logically with a rare clarity and impartiality. On the problem of the origin of life he refines his views of 1914 to the simple statement that ". . . it may be the case that the problem is only a pseudo one and that it is just as foolish to inquire into the origin of life as it would be to ask what was the origin of the universal tendency to entropy increase. We have no doubt that *the distinction between living and lifeless things is a problem for physics* [present writer's italics]. We have no confidence that the basal conceptions of physics have been established. That being so, it is futile further to continue this discussion".

On this problem—as on many others—the philosopher and research worker discloses the apparent inadequacies of present-day knowledge. In this way James Johnstone leaves his problems and work to posterity, with a satisfying and rare record of achievement; and better still, he leaves a memory of a loveable man, wise and humble, great and unassuming.

PROF. C. M. THOMPSON

CLAUDE METFORD THOMPSON, emeritus professor of chemistry of the University College, Cardiff, was born at Bridgwater in 1855, and was the son of Alexander and Eleanor Thompson. He died at Cardiff on January 4, 1933, at the age of seventy-seven years. Some of the following particulars of his career are from the *Western Mail*. Prof. Thompson was educated at University College, London; Trinity College, Cambridge, where he was a scholar; and the University of Bonn. At Cambridge he obtained the degree of M.A.; his D.Sc. was awarded to him by the University of London, which university also bestowed upon him a gold medal for distinction in his subject; and the University of Wales conferred upon him the degree of D.Sc. (*honoris causa*) for his services during and after its institution in 1893. He was the last of the original professors appointed in 1883 when the University College, Cardiff, was opened under the principalship of Viriamu Jones, and he retired from the service of the College in 1921, with the title of emeritus professor, after a successful career as professor of chemistry.

Dr. Thompson's assistance and advice to the University and the University College were particularly useful regarding the details of educational organisation and in the preparation of regulations, courses, and schemes of study for degrees. Up to the time of his death he was a member of the Court of Governors of the College, appointed by the Chancellor of the University of Cambridge. He found time to carry on research work, particularly into the constituents and possible uses of rare earths and their application to commercial products, such as incandescent mantles.

Dr. Thompson was a generous supporter of the University College at Cardiff, and the donor of many volumes and publications on chemistry to its library. In his early days he found his chief enjoyment in mountaineering during vacations; he was a member of the Alpine Club. He identified himself with local interests by becoming a member of the Cardiff Naturalists' Society, in the work of which he was particularly active. He took a keen delight in gardening, and many of the amenities to be found in "Cae Syr Dafydd", one of Cardiff's parks, are largely due to his care and attention. A. A. R.

WE regret to announce the following deaths:

Mr. T. H. Coward, a well-known naturalist and an authority on British birds, on January 29, aged sixty-six years.

Sir Percy Sargent, C.M.G., formerly surgeon to St. Thomas's Hospital and the National Hospital, Queen Square, London, and Hunterian professor of surgery and pathology at the Royal College of Surgeons in 1928, an authority on brain surgery, on January 22, aged fifty-nine years.

Dr. John Thomas, joint managing director of the Dyestuffs Group of Imperial Chemical Industries, Ltd., a well-known authority on dye-stuffs, on January 18, aged forty-six years.

News and Views

Dr. G. D. Hale Carpenter

The vacancy in the Hope professorship of zoology at Oxford, caused by the resignation of Prof. E. B. Poulton, has been filled by the appointment of Dr. G. D. Hale Carpenter. Dr. Carpenter is widely known for his investigation of the bionomics of the tsetse fly, *Glossina palpalis*, a work undertaken by him between the years 1910 and 1914. During this time he resided first at Jinja on the north shore of Victoria Nyanza, and afterwards on various islands, especially those of the Sesse archipelago, lying in the north-west corner of the lake. While the primary object of his living in this region was the study of the tsetse fly as the carrier of sleeping sickness, Dr. Carpenter found occasion to make many important observations on the natural history of the islands, especially in regard to the remarkable phenomena of mimicry shown by the swallow-tail butterfly, *Papilio dardanus*, and the series of forms of the nymphaline *Pseudacraea eurytus* mimicking the acraeine genus *Planema*. At the outbreak of the War, he was called upon to act as medical officer to the forces operating on the southern frontier of Uganda, in German East Africa and Portuguese East Africa; and amidst the duties of active service he found opportunities for further fruitful observation, opportunities which were increased and turned to fresh account on his return to Uganda in 1918. His book "A Naturalist on Lake Victoria" was published in 1920. Dr. Carpenter's work has throughout been influenced and inspired by Prof. Poulton; and there is every reason for anticipating that the traditions of the Hope Department will be worthily carried on by the new professor.

Pierre André Latreille

Pierre André Latreille, the brilliant French naturalist, who devoted himself to the study of entomology and made considerable additions to our knowledge of that branch of natural science, died in Paris a hundred years ago on February 6 at the age of seventy-one years. Latreille was born on November 29, 1762, at Brive-la-Gaillarde, in the department of Corrèze. At the age of sixteen years he entered the Collège Lemoine, Paris, where he studied for the church. After he had taken orders in 1786, he retired to Brive, where he devoted himself chiefly to the study of insects. He returned to Paris in 1788, and during the Revolution was imprisoned at Bordeaux; but was released on account of the interest shown in his entomological studies. His great work, "Précis des Caractères génériques des Insectes, Disposés dans un Ordre naturel"—an important step towards a truly natural system of entomology—was published in 1796, and led to his being appointed to arrange and take charge of the entomological collection at the Muséum national d'Histoire naturelle (Jardin des Plantes) in Paris. He became professor of natural history at the Museum in 1830, and succeeded Lamarck as professor of zoology. Latreille wrote the entomological part of Cuvier's "Règne Animal". His other important works are "Salamandres", "Singes", "Crustacés et Insectes", "Reptiles", "Genera Crustaceorum et Insectorum", "Considerations générales sur l'Ordre naturel des Animaux", "Familles naturelles du Règne Animal", and "Cours d'Entomologie".

Geological Society Awards

The Council of the Geological Society of London has made the following awards for this year: *Wollaston Medal*, to Prof. Marcellin Boule, professor of palæontology in the Muséum national d'Histoire naturelle, Paris, in recognition of the value of his researches concerning the mineral structure of the earth, and especially for his contributions to the geology and vertebrate palæontology of the Tertiary period; *Murchison Medal*, together with an award from the Murchison Geological Fund, to Dr. A. L. Du Toit, consulting geologist, Johannesburg, in recognition of the value of his work, especially on the geology of South Africa; *Lyell Medal*, together with an award from the Lyell Geological Fund, to Mr. J. E. Richey, Geological Survey of Great Britain (Scottish Office), for his researches in the Tertiary volcanic geology of the British Isles; *Bigsby Medal*, to Mr. E. J. Wayland, director of the Geological Survey of Uganda, in recognition of the value of his geological researches, particularly in Uganda; *Wollaston Fund*, to Mr. A. Wrigley, for his work on the Tertiary Mollusca of the London district; *Murchison Fund*, to Mr. T. H. Whitehead, Geological Survey of Great Britain, in recognition of the value of his work on the Carboniferous and older rocks of the Midlands; a moiety of the *Lyell Fund* to Mr. A. Broughton Edge, in recognition of the value of his geophysical work in application to geological problems; a second moiety of the *Lyell Fund*, to Mr. W. N. Edwards, Natural History Museum, in recognition of the value of his researches on fossil plants.

Stoke Park (R. G. Burden) Fund for Research in Mental Disorders

Mrs. R. G. Burden, of Clevedon, Somerset, has offered a sum of £10,000 for research into mental problems and disorders, suggesting that Prof. R. J. A. Berry, Director of Medical Services, Stoke Park Colony, Stapleton, Bristol, shall have general control of the investigations. In view of the munificence of this donation and the importance to the nation of its objectives, it has been deemed advisable to form a strong and nationally representative committee of administration. This committee will be responsible for the general direction of the research, the appointment of the research staff, the determination of salaries, and the publication, from time to time, of such reports as it may think fit to issue. Arrangements have already been made for the representation on this committee of the Ministry of Health (Board of Control), the British Medical Association, the

Francis Galton Laboratory for National Eugenics at University College, London, the Royal Medico-Psychological Association, the Central Association for Mental Welfare, and for other representative individuals specially selected for their scientific or medical attainments. In accordance with the terms of the bequest, Prof. R. J. A. Berry will act as chairman of the committee, which will meet in London at the house of the British Medical Association, with Dr. G. C. Anderson as its honorary secretary. As the committee has not yet met, nothing has been determined as to the nature of the researches to be carried out, though doubtless one line of approach will be the hereditary transmission, or otherwise, of mental deficiency and other disorders. Applications will shortly be invited for a specially selected team of investigators, particulars of which will be made known later.

Preliminary Tests for Everest Flight

A WESTLAND *PV*–3 type two-seater biplane, named the *Houston-Westland*, fitted with a Bristol Pegasus *S*.III engine, piloted by Mr. H. J. Penrose, test pilot at the Westland Aircraft Works, reached a height of 35,000 ft. at Yeovil on Wednesday, January 25. The total time in the air was about 1 hr. 40 min. This constitutes a world's record for a two-seater aircraft. This machine has been specially adapted to undertake a flight over Mount Everest in conjunction with an expedition led by Air-Commodore P. F. M. Fellowes, with Lord Clydesdale as pilot. Specially designed electrical heating apparatus includes not only heated clothing, but also warming devices for the cabin, the valves of the oxygen apparatus for breathing, many of the instruments and jackets for the cameras. The pilot's cockpit is a normal open one, but is fitted with a hooded windscreen as a protection against draughts. The observer's cockpit is roofed over and is provided with sliding windows in either side and the floor for photographic purposes. Williamson Eagle cameras and cinematograph apparatus are to be used. The machine weighs about 5,000 lb. fully loaded as for the Everest flight, and, as is usual with supercharged engines, carries a propeller that allows the full horse power to be developed only after passing 13,000 ft. height. Temperatures down to −40° C. were registered inside the observer's cabin at the extreme altitude reached. The elimination of vibration, to assist the photography, has been specially dealt with, and in this respect the flight was very successful. A second machine is being converted similarly to take part in the expedition.

Aircraft in Relation to Petroleum Technology

THIS subject has recently received a good deal of technical and non-technical publicity, both in Great Britain and abroad. Resulting from the extensive use of aeroplanes during the War for reconnaissance and survey purposes, aircraft operations afterwards gained a firm foothold in the technique of exploration, particularly in inaccessible territory. Developments were rapid and the applications to map-making were perfected and commercialised. The incidence of aircraft as an important factor in geological studies is of more recent date and primarily owes its recognition to the important work carried out in North and South America in connexion with exploration for petroleum, including the survey of pipe-line tracks. Both in the realm of petroleum technology and mining geology, aerial reconnaissance and photography have proved valuable as time- and money-saving factors. The literature on this aspect of the subject has grown extensively during the last few years, and probably one of the most complete accounts of the subject was given by Mr. Donald Gill before the Institution of Mining and Metallurgy recently, when he dealt with "Aerial Survey in Relation to Economic Geology". This paper contains a useful bibliography, which has been reproduced with additions by Mr. H. Hemming, who discussed the commercial aspects of the subject at a meeting of the Institution of Petroleum Technologists on January 10. Mr. Hemming showed clearly that the main value attached to the use of aircraft in exploratory work is for obtaining rapidly information of technical value, and for transporting personnel or material from one place to another. He gave a very succinct account, not only of what has already been accomplished in this direction, but also of the potentialities of further development of air survey.

Empire Broadcasting

SINCE the opening of the Empire Broadcasting Station at Daventry on December 19 (see NATURE, 131, 16, Jan. 7, 1933) the British Broadcasting Corporation has received a large number of cablegrams reporting reception of the transmissions in all parts of the world. A very large number of letters has also been received from listeners, and extracts from some of these are published in recent issues of *World Radio*, which is now the official organ of Empire broadcasting. Good quality reception is reported from such places as Bagdad, the Federated Malay States, Zululand, Tanganyika, various parts of India, New Zealand, and North and South America. In some places, particularly South Africa, local atmospheric conditions have marred the reception to some extent, but on the whole it would appear from the first few weeks' tests that the inauguration of the new Empire broadcasting service has been a conspicuous success. The aerial arrays and the transmitters for the Empire Broadcasting Station at Daventry were designed, constructed and installed by Messrs. Standard Telephones and Cables Ltd.

Anthropological Survey of Ireland

A FIVE-YEAR plan for an anthropological survey of Ireland has been formulated by anthropological members of Harvard University. It will cover the archæology, social anthropology and the physical characters of the Irish people. In a preliminary account and progress report of the survey (*Science*, vol. 76, No. 1978) its object is said to be "to produce some sort of scientific interpretation of the Irish people". The proposal has been cordially received in Ireland, and now has the official approval of the President of the Irish Free State. The archæological section of the expedition is already at work and during the past summer, under the leadership of Dr. O'Neil Hencken and under the auspices of the National Museum of Ireland, has been engaged in the excavation of a Viking age crannog at Ballinderry, Co. Westmeath, and of bronze age burials nearby at Knockast, with remarkable results. For the study of social anthropology, Co. Clare has been chosen as the area affording most typically a blend of the old and the new in Irish culture. A preliminary survey has been made by Prof. W. Lloyd Warner, assistant professor of social anthropology in Harvard University, assisted by Mr. Conrad Arensburg, post-graduate anthropological student of the University. It is intended to devote two years with an extended staff to the observation of every aspect of Irish social life. Physical anthropology will be under the charge of Prof. E. A. Hooton, of Harvard University, who will also be responsible for the general oversight of the work of the expedition.

Excavation in Alaska

DURING the past summer an expedition of the University Museum of Pennsylvania, conducted by Miss Frederika de Laguna, has been at work on the coasts of Alaska in conformity with the policy of American anthropology for the intensive study of this area in relation to the problem of the early peopling of America. The expedition was engaged in the excavation of a prehistoric village site in Kachemak Bay, Cook Inlet. Of the finds of the season, Science Service (Washington D.C.) reports that Miss de Laguna regards the outstanding object to be a carved stone lamp. In the bowl of the lamp is a human figure in an attitude of prayer carved in full relief. Four other examples of such lamps are known ; but this is the only example to be found by a scientific explorer *in situ*. It is said to come from the last phase of four prehistoric Eskimo settlements ; but although the early phase of the 'archaic' culture of the area is remarkable for its carved ivories, stone carving is not known as an Eskimo technique. The lamp was found in a shell-heap close to the sea, which is washed by high tide. Other cultural features of the same settlement were slate mirrors, slate blades for lances, bone harpoons and dart heads, grinding stones, awls, drills, dolls, beads and needles. Rock-paintings were found in caves. Such paintings are known only in southern Cook Inlet and on Kodiak Island, where the culture is similar. The Indians of to-day believe that these pictures were painted by 'whale killers', much feared medicine-men who poisoned their lances with human fat. If there were any foundation for this belief, it might be related to the traces of cannibalism found in prehistoric settlements by the Smithsonian Alaskan expeditions.

Spelling of Place Names

THE United States Geographic Board has published a "First Report on Foreign Geographical Names" (Washington Government Printing Office, 1932. 10 cents). The list of names is prefaced by a long discussion of the problems involved, which is followed by certain general rules that the Board has adopted. The conventional English usage is adopted for the names of countries, dominions, colonies, etc., and for geographical features common to several States in which the official languages are different. For local geographical names in States where a Latin alphabet is used, the names are spelled in accordance with local usage but conventional English forms, where such exist, are accepted as alternatives. Names in non-Latin alphabets are to be transliterated according to either official transliteration, where such exists, or a system adopted by the Board and printed in this report. The practice of translating names is discouraged. The policy adopted by the Board differs little from that used by the Permanent Committee on Geographical Names for British Official Use. The differences lie in the spelling of names in possessions of European powers and in the transliteration of 'j' and 'zh' in certain languages, but it is laid down that in the absence of any specific decision of the United States Board, the decision of the British Committee is to be followed in certain cases. The actual list of names in the Report gives pronunciation in many cases but omits it in several names where its addition would certainly be useful.

Forest Fires in Japan

A PAPER on "Forest Fires and Weather" (*Sci. Papers Inst. Phys. Chem. Res.*, Tokyo, vol. 18), by T. Terada and T. Utigasaki, states that the annual loss due to forest fires in Japan is second in magnitude only to that suffered by the United States. Japanese meteorologists might therefore do good service by studying the weather conditions that precede these fires in Japan, and perhaps eventually organising a system of warnings, following the example of the United States. The authors of this paper were led to study this subject with the aid of synoptic weather charts through the known tendency for the fires to break out practically simultaneously in widely scattered parts of Japan. They conclude that such outbreaks are generally associated with the near approach of the 'squall-line' or principal cold front of a depression following an easterly track north of Japan, when the warmer of the two wind currents yields maximum temperatures of 20° C. or more. There seems no *a priori* reason why the front should have anything to do with the matter ; it is easy to imagine that the necessary antecedent conditions are merely a sufficiency of wind and warmth, with no rain and perhaps some special state of the air in regard to its water-vapour content. These conditions might seldom occur except on the approach of a depression. As frequently happens with investigations in which synoptic charts are used, the extent to which the evidence supports the conclusions cannot be gauged accurately unless all the charts are reproduced in great detail. It must have been difficult for the authors to determine the position of the front in relation to the outbreaks, seeing that they had to rely upon newspaper reports for the times of the outbreaks.

The Disturbing Influence of Science

LECTURING to the Science Federation of the University of Manchester on January 23 under the title "The Irresponsibility of Science", Prof. H. Levy asserted that the problems of unemployment and the distribution of leisure are problems which the man of science must help to solve. It is part of the duty of the scientific man to examine the external properties of science and to face the ethical problems which the application of scientific discoveries is liable to create. The habit engendered in the scientific worker by his very method of endeavouring to isolate objects or causes and consider the influence of single factors in a problem has a very real danger in that it leads scientific workers to assume that all scientific questions are independent of ethics. Practically all scientific work, however, has a social aspect and its social properties cannot be clearly separated from its scientific properties any more than theoretical and applied science can be sharply demarcated. At the present time we are being forced to consider indeed the limit beyond which the process of improving the weapons of production is likely to disturb the structure of the original scientific movement itself. The scientific worker cannot ignore the fact that in practice what is intended as a gift of more leisure for all becomes unemployment and loss of consuming power for some. Scientific men must endeavour to find what factors go to the creation of an unstable society under the impact of science in this way. Prof. Levy suggested that scientific men should analyse the tendencies of science so that they could direct them. Science, which has been a revolutionary factor, has now become a disturbing factor in the world, affecting the stability of communities, and the study of that disturbance is one for international science.

Science and the Textile Industry

SPEAKING on January 26 on the textile industry in the course of lectures on industrial affairs which are being given to the students of the Imperial College of Science and Technology, Dr. Kenneth Lee expressed his belief that the rapid development of scientific research will prove the best investment the textile industry can make. The British Cotton Industry Research Association has undoubtedly the best equipped textile research institute in the world, but although about eighty per cent of those engaged in production contributed to it, in relation to the magnitude of the industry the amount subscribed is negligible. Dr. Kenneth Lee believes that if the necessary financial support is forthcoming, we could dominate to a large extent the cotton textile field in the production of new inventions during the next few years. In addition to utilising science, the cotton industry must also employ men in its mills who can understand the work that science is doing. Dr. Kenneth Lee referred in particular to the way in which science, by introducing means of artificial humidification and ventilation, has not only discounted what was once supposed to be a great advantage of the Lancashire industry—its damp climate—but has made it possible to obtain uniform conditions throughout the year with higher output and more efficient use of automatic machinery.

Direct-Current Generators for Electrostatic Precipitation

IN the English Electric Co.'s *Journal* for October, a description is given of the high-pressure D.C. dynamos it constructs for use in electrostatic precipitation plant. The Whessoe Foundry and Engineering Co., Ltd., specialises in apparatus for fog and mist extraction, and the English Electric Co.'s dynamos are specially designed to work with its plant. The removal of suspended particles from large volumes of gas is an important commercial problem at the present time. Electrostatic precipitation is now regarded as the most efficient and economical method for cleaning gases. The English Electric Co. has designed many high-pressure D.C. machines for radio transmission purposes, and the new dynamos are based on the experience gained in radio work. The generating unit for a typical equipment has to supply a current of about 0·15 amperes at a pressure of 45 kilovolts. The unit consists of a driving motor made to suit the local supply, coupled to three generators connected in series. The frames of the machines are insulated from the earth by individual supports of solid porcelain. The whole of the high-pressure apparatus is enclosed by screens which separate it from the driving motor and prevent unauthorised access. A simple interlock on the door renders it impossible for anyone to enter the high-pressure compartment when the generators are running. As a further precaution, every conductor which is at high pressure when the machine is running is connected with the earth when the set is at 'standstill'. Accidental shocks are thus avoided. A notable feature of the set is its ability to withstand a short circuit without a 'flash-over'. A model precipitation equipment was shown in action at the English Electric Co.'s exhibition last November.

Ship Researches at the William Froude Laboratory

DURING the last ten or twelve years, no fewer than twenty-two papers have been contributed to the transactions of the Institution of Naval Architects, the North-East Coast Institution of Engineers and Shipbuilders and other bodies, by the members of the staff of the William Froude Laboratory, National Physical Laboratory, Teddington. Among these papers are six on the effect of weather conditions on the propulsion of ships, seven on the manœuvring of ships and six on the efficiency of screw propellers. The other papers deal with the hulls of flying boats and ship propulsion data. Needless to say, all the papers are of permanent value and they have now been re-issued as vol. 23 of the Collected Researches of the National Physical Laboratory (London : H.M. Stationery Office. 20*s.* net). Arrangements have also been made to publish them in five groups. Each paper is preceded by a short abstract and the volume has an adequate index, but the reprint does not contain reports of the discussions, for which reference will have to be made to the transactions of the various societies. The majority of the papers, of course, deal with investigations carried out with models in the Alfred Yarrow Tank, but three of Mr. Kent's papers on the effect of weather conditions on the propulsion of ships contain his observations made on several voyages across the Atlantic in rough weather, when the routine of the laboratory was abandoned for all the discomforts of the sea.

Recent Acquisitions at the Natural History Museum

THE skin and skull of a hybrid between a lion and a leopard, which was bred in the Gardens of Kolhapur, has been presented to the Department of Zoology by Col. F. W. Wodehouse. This specimen, which had reached the age of three years, resulted from a union between a male leopard and a lioness, there being two cubs in the litter, the other one dying when about two and a half months old. These appear to be the only hybrids between a lion and leopard ever recorded. Among a small collection of mammals from Tanganyika Territory collected and presented by Mr. W. G. Cubitt-Currie is a new species of golden mole belonging to the genus *Chlorotalpa*. Purchases for the Department of Zoology include a specimen of the giant squid, *Architeuthis*, stranded in West Bay, Scarborough, on January 14. It is about 20 feet in length, including the tentacles. A notable addition to the Department of Geology is a complete specimen of the ancient shark, *Hybodus Lauffianus*. This is no less than seven feet long, and was discovered in the Upper Lias of Hobzmader, Württemberg. As with some specimens of *Ichthyosaurus* and other creatures found at this famous locality, not merely the skeleton, but also soft tissues, notably the skin, are present. The Department of Botany has received from the Godman Trustees a further collection of 848 specimens of flowering plants collected by Mr. R. G. N. Young in the Lunda province of Angola. The whole collection forms a valuable addition to our knowledge of the flora of this part of Angola and is especially noteworthy on account of the wealth of material of aquatic species. Amongst the purchases are 540 specimens collected in Brazil by B. H. Krukoff and a further series of 268 type specimens of the liverwort family Jubulearum.

Farmers' Guide to Agricultural Research

THE Royal Agricultural Society of England (16 Bedford Square, W.C.1) has issued the seventh of its series of annual summaries of scientific and economic research (1*s*. 3*d*. post free). The volume deals mainly with work carried out in Great Britain but also includes the results of colonial and foreign investigations so far as they have a bearing on British agriculture. This year the publication has been issued under a new title, namely, "The Farmer's Guide to Agricultural Research in 1931" in place of "Agricultural Research", by which it has been known hitherto. The change has been made in order to emphasise the main object of the publication, which is to provide the farmer with the most up-to-date information in all the leading branches of agriculture in a summarised and simple form. Apart from the title, the character of the volume remains unaltered, except that the section on crop and plant breeding is temporarily suspended and a new section on pests and parasites is included. The remaining sections, on dairy farming and dairy work, prevention and treatment of diseases of animals, farm economics, the feeding of live stock, farm implements and machinery, and soils and manures need only be cited to show how wide is the field of inquiry covered. Since each section is prepared by a recognised authority on the subject, the publication cannot fail to be of interest and practical value to the farmer, agricultural organiser and student.

Trout Fishing in New Zealand

AN interesting communication on the effects of intensive angling on the depreciation of trout-fishing in the Oreti (or New River) in New Zealand is given by Prof. E. Percival in Fisheries Bulletin No. 5 of the New Zealand Marine Department. The European trout when introduced into New Zealand showed remarkable fitness to their new environment by their great growth and in the early years afforded excellent opportunities for anglers. In recent years, however, there have been signs that the fishing is falling off to a considerable extent. This had been popularly attributed to a number of causes, such as the removal of the bush, leading to a decline in the food supply, the destruction of grasshoppers and cicadas by imported birds, or a change in the growth rate of the fish themselves. By examining old anglers' diaries, studying the food supply and growth of the trout, and using the statistics of angling societies, the author has shown that in all probability the decline in the fisheries is due to the great increase in the number of anglers themselves in recent years and to the opening up of fresh regions made accessible by modern rapid means of transport. The apparent decrease in size attained by the fish is due to the killing off of the older fish and the rapid removal of the smaller fish before they have time to reach a large size. In this publication Prof. Percival gives some valuable information on the food relations in inland waters of New Zealand, following up the work he has already done on the fauna of the streams of Great Britain.

Tests of Hearing

A COMMITTEE of the Section of Otology of the Royal Society of Medicine which was appointed in 1929 to consider tests of hearing has now issued its report (Longmans, Green and Co., Ltd., London. 2*s*. 6*d*.). Tests of hearing by tuning forks, which are widely used, were first considered. It was found, however, that there is no uniformity in the kinds or construction of forks employed by otologists. The Committee obtained the advice of Sir William Bragg and a list of requirements was formulated which was laid before Drs. Kaye, Dye, and Davis of the National Physical Laboratory, who undertook to draw up specifications for the manufacture of standard forks, and Messrs. J. and W. Ragg of Sheffield have completed a set which will shortly be available. The chief features of the standard fork are (1) the place where it should be struck is marked, (2) overtones should be inaudible within ten seconds of the fork being struck, (3) the pitch audible through air and bone to be the same, and (4) the rate of decay shall be such that the half intensity period of the vibrating fork in air shall be between three and ten seconds. Recommendations on the use of forks are given, the classical qualitative tests of hearing are surveyed and their clinical significance stated, and quantitative tests are discussed. Several memoranda on various aspects of the subject are contained in an appendix. The report is one of considerable value and interest.

American Association for the Advancement of Science

On December 30 the following officers of the American Association for the Advancement of Science were elected: *President:* Dr. Henry Norris Russell, Princeton University; *Permanent Secretary:* Prof. Henry B. Ward, University of Illinois; *General Secretary:* Prof. Burton E. Livingston, Johns Hopkins University; *Treasurer:* Mr. John L. Wirt, Carnegie Institution of Washington. *Vice-Presidents and Chairmen of Sections:* A (Mathematics), Prof. C. N. Moore, University of Cincinnati; B (Physics), Dr. C. J. Davisson, Bell Telephone Laboratories; C (Chemistry), Prof. Arthur B. Lamb, Harvard University; D (Astronomy), Dr. V. M. Slipher, Lowell Observatory; E (Geology), Prof. Rollin T. Chamberlin, University of Chicago; F (Zoological Sciences), Prof. A. S. Pearse, Duke University; G (Botanical Sciences), Prof. K. M. Wiegand, Cornell University; H (Anthropology), Prof. T. Wingate Todd, Western Reserve University; I (Psychology), Prof. Walter R. Miles, Yale University; K (Social and Economic Sciences), Dr. Wesley C. Mitchell, Columbia University; L (Historical and Philological Sciences), Mr. Waldo G. Leland, American Council of Learned Societies; M (Engineering), Mr. C. F. Kettering, General Motors Corporation; N (Medical Sciences), Prof. Charles R. Stockard, Cornell University; O (Agriculture), Mr. A. R. Mann, Cornell University; Q (Education), Prof. Walter F. Dearborn, Harvard University.

Announcements

It is announced that Sir Charles Reed Peers, president of the Society of Antiquaries, has been appointed a trustee of the British Museum in succession to the late Viscount Dillon, who died on December 18.

The Council of the Institution of Naval Architects has awarded the premium for the year 1932 to Dr. G. Kempf, and Herr H. Lerbs, of the Hamburg Experimental Tank, for their joint paper: "Cavitation Experiments on a Model Propeller".

At the meeting of the London Mathematical Society on February 16 at 5 P.M. at Burlington House, Prof. P. A. M. Dirac will deliver a lecture on "The Relation between Classical and Quantum Mechanics". Members of other scientific societies are invited to attend the lecture.

At the ordinary scientific meeting of the Chemical Society held on January 19 the President announced that Prof. S. Sugden had been appointed honorary secretary until the annual general meeting on March 30, and that the Council had nominated Prof. G. T. Morgan to the office of president and Prof. S. Sugden and Dr. J. M. Gulland as honorary secretaries to fill the vacant places that fall due to be filled at the annual general meeting.

The Council of the National Institute of Agricultural Botany has awarded the Snell memorial medal for 1932 to Dr. Kenneth M. Smith, entomologist of the Potato Virus Research Station, University of Cambridge. The medal is given to mark eminent work in the sphere of potato husbandry and it has been awarded to Dr. Smith in recognition of his valuable research work on the virus diseases of the potato. This has not only thrown much light on the methods of transmission of these diseases but has also had far-reaching influences on the whole plant virus problem.

As a result of further conferences between the "Dechema" (Deutsche Gesellschaft für chemisches Apparatewesen), the Verein deutscher Chemiker, the Verein deutscher Maschinenbauanstalten and the civic authorities of Cologne, it has been decided that, without interfering with the preparations in hand for the chemical plant exhibition "Achema VII", the date should be changed. The date for the exhibition, which will be held in Cologne, has therefore been finally fixed for May 18–27, 1934. The exhibition "Kautschuk" of the German Society for Rubber Industries which was to be held in conjunction with "Achema VII" will take place independently during 1933 in Cologne.

Applications are invited for the following appointments, on or before the dates mentioned :—Lecturers and instructors in various scientific subjects in evening institutes of the London County Council—The Education Officer, The County Hall, London, S.E.1 (Feb. 10). An Esher research student to carry out research in the history or archæology of London—The Secretary, London Museum, Lancaster House, St. James's, London, S.W.1 (March 11). A professor of agriculture at the University of Reading—The Registrar. An engineering workshop instructor and lecturer in workshop processes, drawing, calculations and science at the Borough Polytechnic, Borough Road, London, S.E.1—The Principal.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Whale Shark in the Waters Around Ceylon

FROM time to time since 1862, whale sharks have been reported from the waters around Ceylon. In addition a number of incidental accounts based on erroneous identifications have been published. In the progress of an article on the geographical distribution of this great fish, these references have been looked up and it now seems a good opportunity to set forth the accurate accounts and designate those which are erroneous.

The earliest reference of all is that by Capt. James Steuart in 1862[1]. In writing of the pearl fishery, he noted that sharks were common and specifically stated that " . . . on two occasions my attention has been called to spotted ones of such monstrous size as to make the common ones at their sides appear like pilot-fish".

In 1883, and again in 1884, Haley[2] recorded the capture, at Moratuwa near Colombo, of a comparatively small specimen (23 ft. 9 in. long). This was mounted and is on exhibit in the Colombo Museum; for a figure of this see Gudger[3], 1931, pl. xxx. Haley[2] also recorded (1890) the capture in 1889 of an 18-ft. specimen at Ngombo, on the western shore just north of Colombo. The skin was sent to the British Museum and mounted; for figures of it, see Günther[4] (1889) and Gudger (1931, pl. xxxi). Lastly, Thurston[5] (1894) stated that in April, 1890, another small fish (14·5 ft.) was taken off Bambalapitya. I have been unable to identify this locality, but it is interesting to note that the other two specimens came from the west coast, and that all three were relatively small fish.

These are the substantiated records for Ceylonese waters. Other specimens of the whale shark have been taken off the Indian peninsula not far away. They will be noted in the paper on the distribution of the fish, but in the present article two indefinite and, in my judgment, erroneous references to the presence of this shark in Ceylonese waters must be cleared up.

The first of these is in A. E. Shipley and James Hornell's "Further Report on Parasites Found in Connection with the Pearl Oyster Fishery at Ceylon" (in W. A. Herdman's Report to the Government of Ceylon on the Pearl Oyster Fishery of the Gulf of Manaar, 1905, vol. 3, pp. 53 and 54). On page 53, they listed a trematode "from either a species of *Carcharias* or *Rhinodon typicus*, the 'basking shark' of tropical waters". Here already doubt was expressed and in a footnote the authors showed further doubt as to what is meant by the "basking shark". Herdman's recollection was that "the term was applied by the sea-going men to a *Carcharias*". Now, the form and coloration of the whale shark are so remarkable that no one who has seen even a good figure of it could ever mistake another shark for it. Moreover, the note further stated that such a "basking shark" caught on the pearl banks was sent to Boulenger who identified it as *Stegostoma tigrinum*, a shark somewhat similarly marked.

On page 54, Shipley and Hornell described a *Distomum* "taken from the perivisceral cavity of *Rhinodon typicus*". Here again I doubt the identification of the shark. On this point it should be noted that James Johnstone[6], in his report on the fishes taken by Herdman and Hornell, made no reference to such a shark—the capture of which would have been a notable matter. Further negative evidence will now be submitted.

Thomas Southwell[7], in his "Notes on the Food of Certain Marine Fishes of Ceylon" on page E 49, wrote: "*Rhinodon typicus.* March 14, 1910. One specimen. Stomach empty." Again, in his "Notes on the Fauna of the Ceylon Pearl Banks",[7] on page E 44, under date of March 18, 1910, of trawling in Dutch Bay, he wrote thus: "*Rhinodon typicus.* Stomach empty, but six huge cestodes in gut. Very ripe ovary. Oviduct full of eggs, 16 cases counted, same form as in dog-fish."

These statements interested me because they apparently gave two other records for *Rhineodon* off Ceylon, and particularly because one account indicated the method of reproduction in this rare shark. To verify and clear this matter up, I carried on an extensive correspondence with Mr. Southwell and with Dr. Joseph Pearson, director of the Colombo Museum. Southwell thought that the egg-cases were preserved in the Colombo Museum, but an exhaustive search by Pearson failed to reveal them. Then I turned to the question of identity of the shark. Pearson stated that in long years of trawling with literally thousands of hauls, neither he nor any of his men had ever seen a *Rhineodon*, which he knew well but thought a very rare fish around Ceylon. He suggested that Southwell's shark might be a *Stegostoma*, as Herdman indicated for a similar case above referred to. Southwell replied that he knew *Stegostoma* well and that it was not his fish, that he thought that his identification was correct since it was made from Day's "Fishes of India" (1889, vol. 2, p. 29), but that he might have been mistaken. Now the description of *Rhineodon* on the page cited in Day is so indefinite that it might be applied to almost any of several large barred and spotted sharks. My conjecture is that Southwell's shark might have been a *Galeocerdo tigrinum*. I think that it could not have been a whale shark. Had he seen this shark, its great size and extraordinary markings would most surely have fixed themselves in his mind.

I think that both these references to *Rhineodon* may safely be set down as due to mistaken identifications, and hence may be disregarded in this faunal survey. However, there are left the records of three specimens seen by scientific men, and in addition, Steuart's short account of his encounters with great spotted sharks, which were undoubtedly Rhineodons.

E. W. GUDGER.

American Museum of Natural History,
New York City.

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[1] Steuart, James, "*Notes on Ceylon*", *etc.* London, 1862. (Whale Shark, p. 156.)

[2] Haley, A., "On the Occurrence of *Rhinodon typicus* Smith on the West Coast of Ceylon". *Ann. Mag. Nat. Hist.*, 5 ser., 12, 48–49; 1883. "On *Rhinodon typicus*". Rept. Director Colombo Mus. for 1883, in Ceylon Adminstr. Repts. for 1883, pp. 129D–130D; 1884. "On *Rhinodon typicus*". Rept. Director Colombo Mus. for 1889, in Ceylon Administr. Repts. for 1889, p. 14; 1890.

[3] Gudger, E. W., "The Fourth Florida Whale Shark, *Rhineodon typus*, and the American Museum Model Based on It". *Bull. Amer. Mus. Nat. Hist.*, 61, 613–637, 10 pls., 4 text-figs.; 1931.

[4] Günther, A. C. L., "The Basking Shark [*Rhinodon typus*] of the Indo-Pacific Region". *Graphic*, London, p. 310, text-fig.; 1889.

[5] Thurston, Edgar, "Inspection of Ceylon Pearl Banks". *Bull. Madras Govt. Mus.* No. 1 (Whale Shark, pp. 36–38, pl. IIIA); 1894.

[6] Johnstone, James, Rept. Govt. Ceylon Pearl Oyster Fishery Gulf of Manaar, vol. 2, 201–222, 2 pls., 2 text-figs.; 1904.

[7] Southwell, Thos., Marine Biology, in Ceylon Administr. Repts. 1912–13, Pt. IV—Education, Science, Art.

Properties of X-Radiation

The published accounts of unsuccessful attempts to find the J-phenomenon seem to call for some statement of the present position of investigations on the subject. Our experience of the phenomenon is now so extensive, that the comments and suggestions of experimenters are to us of little more than psychological, or shall we say philosophical, interest. Their results represent, at most, an almost negligible number of observations under conditions which we are able to reproduce at any time; they add nothing to our knowledge.

These negative results, that is results showing no J-discontinuity, are neither more nor less accurate, neither more nor less real, than those which show the discontinuity. Results of one kind follow laws which are now familiar to physicists; the others are governed by laws which are not as yet generally recognised. It is to the apparent violations of known laws and not to further confirmation under very precise and specialised conditions that we must look for advances in knowledge. The very rigid limitation of the number of variables, usually imposed upon the experimental conditions, is a most effective barrier to discovery in regions which have not been thoroughly explored. These limitations we have tried—indeed experience has taught us—to avoid.

The *reality* of a J-discontinuity can be established by an observer in an hour's time; the wide generality of the phenomenon has however taken months and even years to establish. The laws which govern it have been studied for thousands of working days and certain general conclusions have been reached. How general these laws are, cannot, of course, be told. But they show with certainty that what have previously been regarded as the fundamental laws of X-ray action are not valid; and they introduce us to entirely new conceptions of X-ray phenomena. It is quite evident that not only is the J-absorption-discontinuity conditional on some unidentified factor but that even the K-absorption edge (discovered by us some twenty-five years ago, and now perhaps too faithfully accepted) is conditional, and not perfectly general. In fact, the whole activity of a radiation in a substance is not governed solely by the wave-length of the radiation and the nature of the substance. Confirmation of this statement will be found in the work of Lindh and others on the absorption of X-rays by light substances—work which showed as alternative results absorption lines and absorption edges. It is such alternative results which we have frequently described in association with the J-phenomenon.

In this laboratory we have observed the disappearance of the K-absorption in a way so pronounced that there is no mistaking it.

It may be that many more years must pass before the results discovered can be attributed to one or two simple measurable quantities. The simplest interpretation has yet to be found. But it is important to know that current theories completely break down—that the quantum (or photon) may become impotent; that an atmosphere of radiation (not independent quanta or harmonic constituents) is effective; that superposed radiations act as a coherent whole; that, so far as the radiation is concerned, something analogous to temperature of radiation is the dominant factor; that the internal state (and history) of a substance (not simply the nature of constituent atoms) determines its behaviour under X-ray action. How far these conclusions apply to the K and L phenomena has yet to be determined, but even *their* conditional nature has been established. Detailed accounts will be published in other journals.

C. G. Barkla.

University of Edinburgh.
Nov. 18.

Carbonyls of Lithium, Rubidium and Cæsium

The carbonyls of certain alkali and alkaline earth metals have been prepared previously by the action of carbon monoxide on a solution of the appropriate metal ammoniate in liquid ammonia. In this way, Joannis[1] obtained sodium carbonyl, NaCO, and potassium carbonyl, KCO; Gunz and Mentrel[2] barium carbonyl, Ba(CO)$_2$ and Roederer[3] strontium carbonyl, Sr(CO)$_2$. In the course of researches on the carbonyls proceeding in these laboratories, the corresponding compounds of lithium, rubidium and calcium have been obtained.

The carbonyls were prepared by condensing pure, dry ammonia on to a clean specimen of the metal in question by immersing the containing vessel in a bath at − 60°. After complete dissolution, which occupied about 45 minutes, the excess of ammonia was allowed to evaporate, a gentle stream of pure, dry carbon monoxide being meanwhile passed through the apparatus and continued until the metal ammoniate was wholly transformed into the carbonyl. Because of the highly reactive nature of the metals, ammoniates and carbonyls, all the operations were conducted with the rigid exclusion of both air and moisture.

Lithium carbonyl, LiCO, is a white pulverulent substance quantitatively synthesised by these means: found Li 18·80, 19·62, 21·05 per cent, mean 19·82 per cent; calculated for LiCO, 19·86 per cent. It darkens on standing owing presumably to the liberation of minute amounts of carbon, and, on heating in a vacuum, it begins to decompose at 300° without detonation but with the separation of carbon. At about 500° this change is completed in a short time, the residue consisting of free carbon, carbonate and oxide, the amount of residual carbon indicating that the reaction takes the course,

$$4\text{LiCO} = \text{Li}_2\text{CO}_3 + \text{Li}_2\text{O} + 3\text{C} ;$$

ratio LiCO mol./C atoms, found 1·57, calculated 1·33 (the high ratio being probably due to the loss of carbon in the colloidal form). When treated with water the carbonyl detonated violently, with instant ignition of the gaseous products, a cloud of soot being produced and a residue of carbonate and carbon left. On the other hand, water vapour was absorbed quietly with the formation of a dirty brown liquid. The carbon from the detonation of the carbonyl gave ratios LiCO mol./C atoms lying between 2·5 and 3·5. These results together with those of Joannis, who showed that the gas from the detonation of sodium carbonyl with water contained 86 per cent hydrogen and 14 per cent carbon monoxide, indicate the probability of more than one reaction: the high proportion of hydrogen, together with the presence of carbonate in the residue accords well with a reaction of the type,

$$2\text{LiCO} + \text{H}_2\text{O} = \text{Li}_2\text{CO}_3 + \text{C} + \text{H}_2$$

involving the reduction of water by the carbonyl, which requires LiCO/C = 2.

Rubidium carbonyl is a pure white solid possessing as ordinarily prepared a nacreous lustre and dissolving readily in water to give a pale yellow solution. Quantitative synthesis gave Rb 76·55, 74·89 per cent; mean 75·72 per cent; calculated for RbCO, 75·35 per cent. The lilac colour attributed to some of these carbonyls only appears when the conversion from ammoniate to carbonyl is incomplete, and is undoubtedly due to a fine dispersion of the former material. When rubidium carbonyl is heated in a vacuum, the usual dissociation sets in about 350°, and proceeds with increasing rapidity as the temperature is further raised, carbonate, carbon and oxide being produced.

Calcium carbonyl is a dirty, cream coloured, pulverulent powder: found Ca 40·75, 43·66 per cent; mean 42·21 per cent; calculated for $Ca(CO)_2$, 41·70 per cent. With water, it darkens in colour and partially dissolves with the evolution of heat, but without detonation. When heated in a vacuum it gives carbon, carbonate and oxide, the reaction commencing about 200° and increasing in velocity as the temperature is raised.

T. G. PEARSON.

University of Durham,
Armstrong College,
Newcastle upon Tyne.
Nov. 14.

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[1] *C. R. Acad. Sci.*, **116**, 1518; 1893.
[2] *Bull. Soc. Chim.*, (3), **29**, 585; 1903.
[3] *Ibid.*, **35**, 715; 1906.

Systems of Four Immiscible Liquid Layers

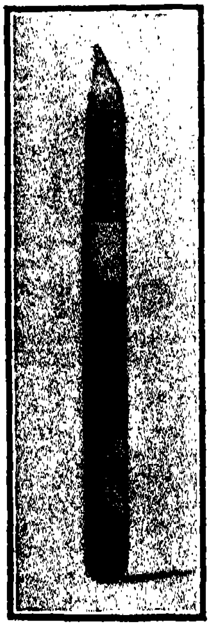

FIG. 1.

IN a recent letter Prof. J. R. Partington[1] states that the system of four immiscible liquid layers described by me[2] does not appear to be stable, inasmuch as a specimen, that originally separated into the four layers, now forms two only. A little more than two years ago I prepared a sealed tube containing this system, plus mercury. It has been shaken repeatedly, but still separates into five layers. Moreover, there has been no noticeable tendency for any one of the layers to decrease in volume, much less to disappear. A recent photograph of this tube is reproduced as Fig. 1. A second specimen, made about the same time, behaved in precisely the same way.

It is difficult to account for the instability of Prof. Partington's specimen, unless indeed impure materials were used (for example, the best oleic acid obtainable commercially is impure) or unless precautions were not taken to exclude atmospheric oxygen and carbon dioxide. The latter will decompose the soap, and the four layers will become three. This might conceivably happen within two years through the action of atmospheric carbon dioxide if the specimens were stoppered with cork or rubber; but then under such conditions the hexane might evaporate away. The suggestion that some decomposition has occurred, or that impure materials were used, is supported by the fact that the two layers of the unstable specimen are reported to be brown in colour.

The phase rule does not demand that systems shall remain in equilibrium in the presence of reactive substances not included among the components. Indeed, it is applicable even when slow interaction between the components occurs. For example, Schreinemakers' studies of the system succinic nitrile, water,[3] and my own of the system sodium oleate, sodium chloride, water, ethyl acetate,[4] are not invalidated because the nitrile and the ester respectively are slowly hydrolysed by the water. These systems would certainly not remain in equilibrium for two years, but as it happens the system under consideration is not of this type. Provided that it is prepared with pure materials and suitably sealed, it seems likely that it will remain unchanged indefinitely, thus constituting the first example of a system of four immiscible liquid layers in permanent true equilibrium. This claim is sufficiently established by the single example illustrated in the accompanying photograph, and is not weakened by the fact that the same phenomena may not be manifested under slightly different conditions.

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[1] NATURE, **130**, 967, Dec. 24, 1932.
[2] NATURE, **127**, 91, Jan. 17, 1931.
[3] *Z. Phys. Chem.*, **23**, 418; 1897.
[4] *J. Phys. Chem.*, **36**, 2455; 1932.

Vacant Positions in the Iron Lattice of Pyrrhotite

PREVIOUS investigations on the solubility of sulphur in iron sulphide (FeS) have led to the conclusion that the solid solutions of sulphur in iron sulphide are formed by substituting some of the iron atoms in the original lattice by sulphur atoms. Assuming that the radius of the sulphur atoms is smaller than that of the iron atoms, this hypothesis explains the fact that the lattice dimensions decrease with increasing sulphur content. It seems, however, doubtful if this relation between the radii of iron and sulphur atoms agrees with reality, and the difficulties are still more increased when one has to explain the analogous (only more pronounced) lattice variations in solid

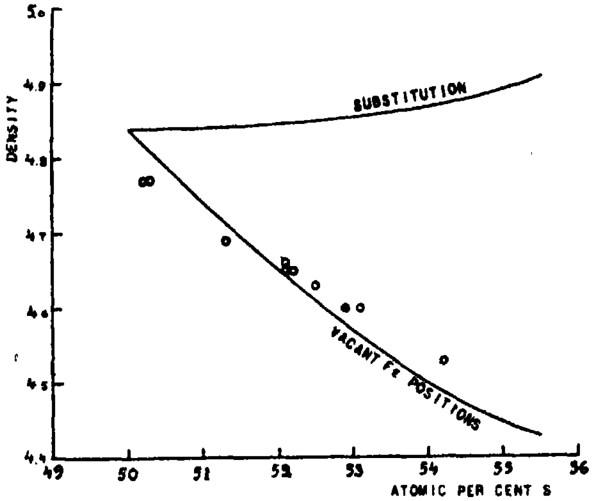

FIG. 1.

solutions of selenium in iron selenide (FeSe) in the same way, on the assumption that the selenium atoms are smaller than the iron atoms.

There exists, however, a second explanation of the observed effect, which requires no special relation between the sizes of the two kinds of atoms, namely, that the excess of sulphur is caused by an increasing number of vacant positions in the iron lattice. Recent X-ray measurements carried out in this Institute show that the phase of the 'nickel arsenide type', constituting the solid solutions in question, is homogeneous from about 50 to about 55·5 atomic per cent sulphur, and by means of the lattice dimensions observed, the density has been calculated for a solid solution of the substitution type and for the type characterised by vacant iron positions. The curves are shown in Fig. 1 together with previously observed density values, which strongly favour the assumption of such vacant positions.

Theoretically, it should be possible to decide the question also by intensity measurements of the X-ray interferences, but in this case the difference necessitated by the two theories is too small to be detected. A study of the solutions of selenium in iron selenide, where the difference should be more marked, and also where the density measurements probably will give a still more striking difference, has been begun.

No definite facts indicate a regular distribution of the vacant positions, so possibly they might be distributed at random in the iron lattice. Theoretically, the appearance of random vacancies is as natural as the appearance of random substitution, or of a random adding of dissolved atoms into the interstices of a lattice. These vacant positions make a new type of solid solution like the above possible, and the possibility of their appearing should be kept in mind in the determination of any structure where they are not electrostatically impossible.

In this connexion it might be mentioned that the present study has shown that the phase under investigation exhibits a 'superstructure' at the homogeneity limit richest in iron, that is, at the composition FeS. The symmetry is still hexagonal, but the longest basal diagonal of the old unit cell (of the nickel arsenide type) becomes the *a*-axis in the super cell, while the *c*-axis of the old cell is doubled. The new super cell contains 12 iron and 12 sulphur atoms. The superstructure disappears rapidly when the sulphur content of the phase increases.

Gunnar Hägg.

Institute of General and
Inorganic Chemistry,
University, Stockholm.
Dec. 17.

Positive Ion Emission from Oxide Catalysts

It was shown recently in this laboratory[1] that the emission of positive ions from a heated Kunsman catalyst is accompanied by the evaporation of neutral atoms. In particular, a cæsium source heated in the neighbourhood of a sodium source deposited cæsium on the latter, so that when it was heated in turn, it emitted cæsium and not sodium ions. The number of cæsium ions emitted from the sodium source was large in this sense that it corresponded to the deposition on the superficial area of the source of a layer of cæsium a thousand atoms thick.

Cæsium atoms evaporate uncharged from cæsium in bulk and a layer more than two or three atoms thick must behave in the same way. Thus we find that cæsium deposited in varying thicknesses on a tungsten surface, which is then heated, always results in the emission of the same quantity of positive charge. This charge corresponds to the emission of the last layer of the cæsium on the tungsten, which is held to the surface as ions, the overlying atoms being evaporated in the neutral state. In the experiments with the oxide sources, the cæsium must therefore have been distributed on the surface of the microcrystals throughout the source. At temperatures below that at which the cæsium evaporates appreciably, the cæsium atoms must be able to migrate over the crystal surfaces, possibly in the way suggested by Lennard-Jones[2], so that the deposition results in a large surface being covered by a monatomic layer of cæsium ions.

This result suggested that it might be possible to produce positive ion sources of other metals by evaporation on to an iron oxide base, and experiments were made with thallium, indium and gallium. With thallium and indium we obtained very pure sources of the corresponding ions which gave an emission of 20 microamp. per sq. cm. for many hours. With gallium the results were unsatisfactory and the sources soon failed. The ions were identified by mobility measurements in pure nitrogen. In this gas we have found that the determination of the mobility of a positive ion gives an unambiguous measure of its mass[3].

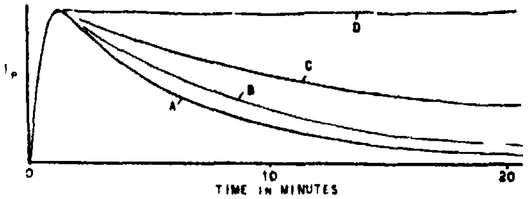

Fig. 1.

To investigate this difference between the different metals, we made experiments in which a known amount of metal could be deposited on the oxide base. After the deposition, the oxide was heated to a given temperature and the resultant positive ion emission measured. In Fig. 1, this emission, i_p, is plotted against the time. Curves *A*, *B*, *C*, *D* are for progressively increasing amounts of deposited thallium. The results showed that a very large proportion, probably 100 per cent, of the deposited metal was re-emitted as ions when the source was heated. Secondly, in all the curves it will be seen that the initial maximum current is the same. This maximum current is the emission, at the given temperature, characteristic of the surface when saturated with positive ions. At the beginning of the heating of the source, the outer surface is fully saturated. Unless it can be maintained in this state by the migration of ions from the interior, the emission falls off. The possibility of maintaining the outer surface in the saturated condition must depend upon the concentration of ions on the crystal surfaces in the neighbourhood of the outer surface. With large depositions these are saturated and the emission remains constant (see Fig. 1, curve *D*).

If for a given metal the emission characteristic of the saturated surface is measured at increasing temperatures, it is found to rise rapidly like the saturated electronic emission from a heated filament. From this curve an approximate value of the positive ion work function can be found. At a certain limiting temperature the iron oxide sinters and the emission falls and becomes unstable. This temperature limitation defines the maximum emission that can be taken from an iron oxide source with a given metal on it. The higher the work function for the positive ions the lower the maximum current. In the mobility experiments with gallium we must have exceeded this limiting temperature in the attempt to obtain the necessary emission.

Details of these experiments, together with others on the properties of surface ionic layers of other metals on various oxides, will be discussed in another place. We may point out here the significance of these results in connexion with the catalytic action of the Kunsman source in the production of ammonia which we have found to take place at low pressures[3] and which is used as an industrial process. The catalytic activity may be assumed to be directly associated with the presence of alkali ions on an enormous area, and any activity of the oxide in the absence of added alkali to the inevitable presence of traces of the alkalis as impurity, for a small mass of alkali will cover a large area as a monatomic film.

C. F. POWELL.
LUANG BRATA.

The Wills Physical Laboratory,
University of Bristol.
Dec. 20.

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[1] Tyndall and Powell, *Proc. Roy. Soc.*, A, **136**, 145; 1932.
[2] Lennard-Jones, *Trans. Faraday Soc.*, **28**, 333; 1932.
[3] Powell and Brata, *Proc. Roy. Soc.*, A, **138**, 117; 1932.

Fusion of Carbon

IN the course of an investigation on the behaviour of the carbon arc in various gases at high pressure, carried out in apparatus provided by Imperial Chemical Industries Ltd., we have obtained large amounts of carbon in a fine state of division. In certain circumstances this carbon is deposited as graphite, all in the form of small spherules of about 0·02 mm. diameter or smaller, having a density 2·25. There seems to be little doubt that these spherules of graphite have been formed owing to the effect of surface tension, the carbon having persisted for a finite time in the molten state. The best yield was obtained at 90 atmospheres in hydrogen with an arc dissipating 20 kilowatts. The temperature of the positive crater at this pressure has not yet been determined. The surface brightness at 10·5 atmospheres was 2·18 times that of the arc at atmospheric pressure for the same wave-length, corresponding to an increase of brightness temperature of 460°. The increase in the thermodynamic temperature must be of the same order, so that the temperature was probably much higher at 90 atmospheres. Further investigations are necessary before the precise conditions under which the spherules are formed are established. The percentage of ash left after burning the carbon of the electrodes was 0·8, that from the carbon collected from the arc chamber less than 3 per cent. It is scarcely likely that this amount of fusible ash could cause the whole of the carbon to adopt spherical form.

Braun[1] has mentioned the formation of microscopic spheres of carbon from thin carbon filaments through which the discharge from a number of Leyden jars was passed, while Lummer's investigations on the peculiar molten appearance of the positive crater in arcs at low pressure described in his book on the "Verflussigung der Kohle" are well known, but no evidence of the melting of carbon is quite so convincing as the appearance of these graphite spherules, obtained in the above manner.

A. EGERTON.
M. MILFORD.

Clarendon Laboratory,
Oxford.
Dec. 15.

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[1] *Ann. Phys.*, 17, 359; 1905.

Liesegang Rings

IN reply to Dr. Bradford's letter[1] I would say that the more comprehensive a theory is, the more general and apparently indefinite must be the terms in which it is expressed. If for my indefinite term 'mobilisation' is substituted the more definite term 'adsorption', my theory of periodic structures becomes almost identical with Dr. Bradford's. But I believe that adsorption is only one of the means by which the substance may migrate towards the structure already formed, and I prefer, therefore, to use the less definite term 'mobilisation' to include all these means.

It is not correct to suppose that in accordance with my theory all systems should give periodic structures, for the critical conditions postulated may be absent or only slightly developed. Nevertheless, it is probable that a system not usually given to periodic structure formation can always be made to furnish periodic structures by alteration of these conditions. This, I believe, is a point also upheld by Dr. Bradford.

ERNEST S. HEDGES.

International Tin Research
and Development Council,
Manfield House, Strand,
London, W.C.2.
Jan. 4.

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[1] NATURE, **130**, 1002, Dec. 31, 1932.

Nitrogen Fixation in the Genus *Lolium*

THE results of some recent experiments suggest that it is highly probable that part of the nitrogen requirement of plants of the genus *Lolium* is met from atmospheric sources.

Experiments were designed to test the effect of withholding atmospheric nitrogen from the plants. The plants were grown in sterile silver sand, which had previously been freed of all traces of nitrogen. The containers for the sand were large specimen tubes. There were two separate series of these sand cultures, one supplied with combined nitrate nitrogen, the other without it. Two sterilised seeds were buried in each tube, four tubes of each type were placed under a bell jar which was made gas-tight, and a mixture of 80 per cent hydrogen, 20 per cent oxygen and 0·03 per cent carbon dioxide was drawn through. A control series of the same types and prepared under the same experimental conditions was run simultaneously under a bell jar through which atmospheric air was drawn. During these early experiments the gas mixture of both chambers was drawn through the sand. The gas in the chambers was changed once every twenty-four hours. The hydrogen and oxygen were prepared electrolytically, and the carbon dioxide by the action of hydrochloric acid on marble chips.

The experiment was kept going for seven weeks.

At the end of that time the plants in the air chamber were markedly healthier and bigger than those in the hydrogen chamber.

A similar experiment was afterwards set up, observing the same precautions, but it was modified to yield quantitative data and to give some indication of the effect of hydrogen on the growth of the plant. Bell jars as gas chambers sufficiently large to cover forty tubes were used. A third chamber was added, through which a gas mixture of, in percentage proportions, hydrogen 40, nitrogen 40, oxygen 20, and carbon dioxide 0·03, was drawn. This experiment was kept going for eight weeks, and at the end of that period the lengths of all the leaves and the dry weights on each plant were determined. The lengths of the leaves were measured as indices of area; the small width of the leaves rendered the direct determination of this quantity extremely difficult. The mean total leaf length in centimetres and the mean dry weight in grams per plant are presented in the accompanying table.

Gas Mixture	Culture Solution		
Nitrogen, oxygen and carbon dioxide	+ Nitrate	Leaf length Dry weight	26·4 0·0018 (1)
	– Nitrate	Leaf length Dry weight	21·5 0·00148 (2)
Nitrogen, hydrogen, oxygen and carbon dioxide	+ Nitrate	Leaf length Dry weight	36 0·00322 (3)
	– Nitrate	Leaf length Dry weight	23·1 0·00164 (4)
Hydrogen, oxygen and carbon dioxide	+ Nitrate	Leaf length Dry weight	27·2 0·00228 (5)
	– Nitrate	Leaf length Dry weight	18 0·00136 (6)

The difference between the dry weights of (2) and (6) is only slightly greater than the standard error of the difference of these means, but the difference in leaf lengths is more than twice the standard error of the difference of the means. The latter difference is, therefore, probably significant. The best growth was that made in the gas mixture containing both nitrogen and hydrogen. The stimulating effect of hydrogen under the conditions of the experiment is also evident from series (5) when compared against series (1). The conclusions would therefore seem to be justifiable that the stimulating effect of hydrogen is masking the depressant effect of absence of nitrogen in (5) and (6).

R. BROWN.

Botanical Dept.,
Seale-Hayne Agricultural College,
Newton Abbot.

Ambiguity in Sign of Spearman's General Factor

IN a previous letter,[1] I gave a sketch of a method for obtaining an explicit formula for the general factor g and the specific factors which occur in Spearman's two-factor theory of intelligence. By developing this method, I obtain the following results.

If the tetrad relations hold, the factors exist. If two more conditions hold, the factors are real. If a fourth condition holds, they are unique except in sign. In the case which occurs most often in actual experiment, when all the coefficients of correlation between the tests are positive, the value of the general factor with one sign seems to correspond to something like general ability and the value with the other sign to the lack of that ability. But in other cases, when some of the coefficients of correlation are negative, it is not clear how to distinguish between the interpretations of the two possible values of the general factor.

After a discussion of the effects of pooling tests, the results have been applied to a dice problem, and to actual sets of mental tests. It is found that both for the dice throws and for the mental tests, the general factor exists and is real, but is not unique, even in numerical value. The comparison between dice throws and mental tests, when examined closely, breaks down in one important respect. Finally, the possibility is examined of making the numerical value of the general factor approximately unique, by making the ratio of the standard deviations of the indeterminate and determinate parts a given small fraction. I have shown that to do this by merely multiplying the number of tests is quite impracticable; the only method available is to choose one or more tests that correlate very highly indeed with g. In the case of Kelley's tests, it is found that the fraction which we wish to make small appears to be 0·09, but that this value is very doubtful on account of the tetrad relations not being satisfied exactly. The use of figures corrected for attenuation leads to the conclusion that either some of the factors are imaginary, or, what is more probable, that the correction for attenuation is not reliable.

A full account of this work will be offered to a psychological journal in the near future.

H. T. H. PIAGGIO.

University College,
Nottingham.
Dec. 21.

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[1] "The General Factor in Spearman's Theory of Intelligence," NATURE, 127, 56, Jan. 10, 1931.

Spectra of Bromine: Br V, VII and IV

IN continuation of our previous work on the spectra of arsenic and selenium, the spectrum of bromine has been investigated by a study of photographs taken under different conditions of excitation. The chief multiplets belonging to the higher spark spectra of bromine have been easily identified. The characteristic intervals of the deepest ^3P terms in Br V and Br VII have been found to be 6090 cm.$^{-1}$ and 7580 cm.$^{-1}$ respectively, while $4p\ ^3P_0 - 4p\ ^3P_1$ and $4p\ ^3P_1 - 4p\ ^3P_2$ of Br V are 2115 and 4906 units.

A full report of the analysis will be published shortly.

The experimental data referred to above have led one of us (A.S.R.) further to the identification of many of the chief groups of Br IV arising from the transition of the electron from the $4p$ to the $5s$, $4d$ and sp^3 states. The intervals of $5s\ ^3P_{0,1,2}$ are found to be 1281 cm.$^{-1}$ and 4688 cm.$^{-1}$. This classification does not agree with the scheme suggested by S. C. Deb[1], which the writer thinks is out of step in the iso-electronic sequence Ge I to Br IV.

A. S. RAO.
K. R. RAO.

Science College,
Andhra University,
Waltair, Nov. 1.

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[1] *Proc. Roy. Soc.*, A, 127, 197; 1930.

Research Items

Hawaiian Feather Cape. In *Man* for January Mr. H. G. Beasley figures in colour and describes a feather-cape from Hawaii, which he acquired for the Cranmore Ethnographical Museum, Chislehurst, in 1932. The cape measures 62 in. round the base and is 25 in. in depth, thus falling into the intermediate series, in which the base-line measurement is that of a full-sized cloak, but the shallow depth that of a cape. The ground-work is of red Iiwi feathers (*Vestiaria coccinea*) and the pattern and border are of yellow Oo (*Acrulocercus nobilis*). The main body of the foundation is somewhat coarse; but the six-inch border is of finer meshed work. The cloak belonged to Sir Joseph Banks and was given by him to his private secretary, Mr. R. K. S. Durham, from whose grandson it was obtained by Mr. Beasley. It is to be presumed that Banks obtained the cloak from one of the officers who sailed with Cook in his later voyages; but the connexion with any one of Cook's voyages cannot be established. In a supplementary note Mr. H. J. Braunholtz adds that the birds from which the feathers were taken were captured alive and often released after they had been plucked. The popular belief that the Oo bird had only two yellow feathers is erroneous: actually the yellow feathers form axilliary tufts containing 15–20 feathers. The feathers are attached to a net of fibre, each separately, by a finer thread of the same material. The use of cotton thread is a sign of modernity. The British Museum now has twenty-six of these feather capes or cloaks, presumably the largest collection in existence. They were first described by Capt. King in his account of Cook's third voyage when the Hawaiian group was discovered in January 1778.

Gods of Maya and Aztec. In an appendix to a study of the calculations of the solar year in Mayan inscriptions on stone stelæ at Quirigua, Guatemala (Field Museum of Natural History, Chicago, Pub. 315, Anthropological Series, vol. 17, No. 4), Mr. J. Eric Thompson considers how far any resemblance may be detected between the Aztec 'Lords of the Night' and the equivalent Maya glyphs of the gods. The sun god is unmistakable. Xiuhtecutli, the fire god of the Aztec, is the Maya glyph in which a flame bracket branches from the god's mouth. In one instance, three balls of flame are shown above the head. Itzli, the second in the Aztec series, has no known Mayan equivalent. Piltzintecutli, the Aztec sun god, in the Maya series is Kinich Ahau, both being associated with a flower or leaves. The fourth Aztec god Centeotl is the maize god, corresponding to the Maya glyph showing a head with the numerical co-efficient of nine and a large human hand, which, the evidence goes to show, denotes an agricultural deity. Mictlantecutli, the Aztec death god, is represented by the Maya glyph with the coefficient of three. Only two examples of the glyph are known and the connexion with death is not clear. The Mayan equivalent for the sixth Aztec 'Lord of the Night', Chalchihuitlicue, goddess of water, through the month sign Mol and day sign Muluc, may also be connected with water. One of the closest parallels is that between Tlazolteotl, the Aztec earth goddess and the Mayan moon goddess, wife of the sun. Both are connected with agriculture, the Aztec through maize, the Mayan through flowers, and both are also concerned with sexual indulgence. The eighth Aztec god, Tepeyollotl, is an obscure earth and mountain deity, who as a jaguar-like animal has a conch shell as symbol. This connects him with a Mayan mountain deity. The ninth and last in the Aztec series is Tlaloc, the rain god. The equivalent Mayan glyph is a young deity with an ear-flap, of which only two examples are known. The association is not clear. Thus in six out of the nine, a remarkable coincidence between Aztec and Maya is apparent.

Making Whole Mounts of Vertebrate Skeletons. Mr. M. Rahimullah and Prof. B. K. Das, of Osmania University College, Hyderabad, have sent a communication describing a method of preparing the whole skeleton, free from soft parts, of a vertebrate, such as a snake or a rat, by a modification of the well known alizarin and caustic potash method. The chloroformed animal is fixed and hardened in strong alcohol (about 92 per cent) for four days, then rinsed in tap water and transferred to a 1 per cent solution of caustic potash. After a period of at least eight days, the bones can be seen through the translucent skin and muscles. The animal is then transferred to a solution of alizarin and caustic potash (made by dissolving 0·1 gm. or less of alizarin *S* in 1,000 c.c. of 1 per cent potash), where it remains for at least twelve days, until the bones take a deep pink hue. The macerated muscles are then dissected away, leaving the skeleton intact. It is not clear from the communication whether the connective tissues uniting the bones have escaped maceration, or whether the articulation of the parts of the skeleton remains to be done in the usual way, but the former claim seems to be made. The hairs of mammals remain opaque, but after a few days in the potash solution they are loose enough to be scraped away with a section lifter or similar instrument. In this way albino rats and young rabbits have been successfully treated.

Early Stages of Hispine Beetles. While there remains still very much to be done in the morphological and anatomical studies of insects in the adult stage, this work is progressing much more rapidly than the study of their immature stages. Researches in the morphology of the latter, however, can be of great interest and value since a number of general biological problems are suggested by them. This is shown very clearly by recent detailed work of S. A. Maulik on the larval and pupal structures in the beetles of the subfamily Hispinæ (*Proc. Zool. Soc. Lond.*, 1932). These larvæ live in tunnels inside leaves and their morphology presents numerous cases of remarkable specialisation due to this mode of life. Thus, the legs show a complete gradation from a well-developed condition to one of great degeneracy, where the claws disappear altogether. The position of the spiracles presents various significant modifications in the larvæ, while their number also varies with the species. In one case the number of larval spiracles was found to vary even within the species and, moreover, there appeared to be a correlation between the number of spiracles in the larva, and the colour pattern of the adult beetle. Some observations point to the possibility of two or more species of the same genus living together in the same tunnel, and this may lead to interbreeding and hybridisation, which would supply a hypothetical explanation of the great variety of colour-patterns in the adults.

Growth of Corals. T. Tamura and Y. Hada record observations (*Science Reports*, Tôhuku Imp. Univ., vol. 7, No. 3, 1932) on the growth of corals in the Caroline and the Pelew Islands respectively. They found that the average annual growth in *Acropora pulchra* was 226 mm. and in *A. digitifera* 12 mm.; the former has a light skeleton, the latter a dense and heavy one. Massive corals, for example, *Porites, Montipora, Favia*, showed an average annual increase in length of about 6 mm., and in weight of about 33 per cent. *Fungia* showed an increase in length of about 9 mm. and in weight 23 per cent. The rate of growth in both localities is similar to that recorded for Hawaiian corals. Each species has a characteristic growth rate; after a specimen reaches a certain size growth ceases. In the preceding paper in the same journal, Y. Hada gives an account of the early stages of growth of *Pocillopora cespitosa*, the planulæ of which are extruded probably throughout the year but most actively during December. The youngest colony found was 1·5 mm. in diameter and consisted of three polyps. The next period of growth results in lateral spreading of the colony until about thirty polyps have been formed; then the colony begins to grow vertically and to branch. The number of polyps now increases about three times as fast as in colonies which are still undergoing lateral extension.

Some Noteworthy Irish Plants. Dr. Lloyd Praeger's paper (*Proc. Roy. Irish Acad.*, 41, Sec. B, No. 7, Dec. 1932) contains much of interest to students of topographical botany, whilst his account of the genus *Cochlearia* in Ireland will be of value to British botanists as ecological observations on the species and notes on hybrids of *C. officinalis* with *anglica, danica* and *grœnlandica*, are given. A revised distribution of these species in Ireland is given, the previous confusion with regard to *C. anglica* being attributed to the frequency with which it hybridises with *C. officinalis*. Investigations on the distribution and associates of *Arbutus* at Lough Gill lead to the conclusion that the plant is native in Sligo, thus extending by 160 miles its northernmost Irish and European limit. The occurrence of *Arctostaphylos alpina* in Ireland and the record of *Euphorbia hiberna* from Roscommon are discredited, whilst the status of *Tamus* as an indigenous plant is re-examined, the author inclining to regard it as native in Sligo. *Polypodium Robertianum* is established as a native species new to Ireland whilst many new stations are given for the hybrid *Equisetum litorale*, and *Scrophularia alata* is recorded from Limerick and Londonderry. Other notes deal with introduced species including *Sarracenia purpurea* from Roscommon and Westmeath, *Erica stricta* from Antrim and Londonderry and an unconfirmed record of *Selaginella Kraussiana* from Donegal.

The Ankole Tinfield. Memoir No. II of the Geological Survey of Uganda is devoted to "The Geology of South-west Ankole and Adjacent Territories, with Special Reference to the Tin Deposits". Apart from an appendix on the petrology of the rocks of the region contributed by A. W. Groves, and a postscript by W. C. Simmons, the memoir is the work of A. D. Combe. It contains a well-illustrated, authoritative account of the geology of south-west Uganda and north-west Tanganyika based on ten years' detailed field work. Cassiterite is the only mineral of economic value that occurs in workable quantities in this area, and though production did not begin until 1927, more than a thousand tons have so far been exported. The mineral occurs in quartz-muscovite-pegmatites and in hydrothermal veins associated with them, veins of hydrous micas and muscovite having proved to be the most important producers to date. All the veins are found in the metamorphosed rocks of the Karagwe-Ankolean system adjacent to the margins of various masses of the so-called Younger Granite. Much of the muscovite with which the tin is associated is thought to have been produced by metasomatic alteration of the phyllites. Combe and Simmons suggest that the alkaline liquors responsible for this alteration also acted as carriers for the tin, but Groves believes that fluorine was probably an active agent in the introduction of tin, despite the absence of topaz. This opinion has also been expressed by Stheeman in a recent book on the same area. The memoir contains a wealth of information on one of the most interesting parts of Uganda and is of importance to stratigraphers because of the attention given to the Karagwe-Ankolean formations and their distribution and correlation, as well as to geologists in general because of the wide range of problems that come under discussion. The memoir is obtainable from the Government Printer, Entebbe, Uganda, price 35*s*.

Meteoric Craters. In a paper to the Royal Geographical Society on January 16, Dr. L. J. Spencer discussed the origins of meteoric craters such as that in Arizona, those in Central Australia and in Estonia or the one recently discovered by Mr. H. St. J. Philby on the site of Wabar in the Arabian desert and described by him in the *Geographical Journal* for January 1933. Little is known about the mode of formation of these craters but the suggestion that they are merely holes formed by the projectile force of the meteor is not an adequate explanation. Meteorites of which the fall has been observed have all been small and their velocity, reduced by resistance of the air, has been about seventy metres a second. They have never penetrated far into the ground. The largest discovered meteorites, the fall of which has not been noted, have not formed craters but lie either on the surface or with their tops flush with the surface. Dr. Spencer suggests that meteoric craters are formed by explosions due to the sudden vaporisation of part of the material both of the meteorite and the surface of the earth as a result of the intense heat generated by the impact. He showed how the destruction of material within the crater agrees with this theory, which also explains the formation of silica-glass found in association with the crater (see also NATURE, Jan. 28, p. 117).

Physical Atomic Weights. In the Liversidge lecture to the Chemical Society (*J. Chem. Soc.*, December 1932), Dr. F. W. Aston described some recent results obtained with the mass-spectrograph. In the case of elements which are mixtures of isotopes, a measurement of the relative intensities of the lines in the mass-spectrogram will lead to an average atomic weight of the element which may be compared with the chemical value. This operation is, however, experimentally very difficult, owing to the circumstances that the source of the positive rays is never reproducible and seldom constant for more than a very short time and also that the relation between relative abundance of isotopes and blackening of the plate is completely different for different elements. Dr. Aston described the experimental procedure adopted in overcoming these difficulties. The results, based on $O^{16} = 16$, require correction by 2 in 10,000 to reduce them to the chemical scale, O = 16, since ordinary oxygen contains the isotopes O^{17} and O^{18}, and a comparison of the two sets of values shows that the agreement is in the great majority of cases exceedingly satisfactory. There is a discrepancy in the case of hydrogen, which cannot be removed by the recent discovery of an isotope of mass number 2, which is present only to the extent of 1 part in 35,000. Scandium, niobium and tantalum, which are simple elements, show discrepancies, their chemical atomic weights being too high, and the same is true, to a less degree, of phosphorus and cæsium. The serious difference in the case of selenium has been removed by Hönigschmid, whose chemical value is identical with the physical one. The physical value for tellurium, which differed from the chemical one, has been corrected by Bainbridge, whose result agrees with the chemical one. The values for osmium and uranium are also abnormal.

Simple Molecules and Elementary Processes. Two lectures by Prof. A. J. Allmand on the above subject have been published by the Institute of Chemistry, and form a very clear and concise introduction to a field of research which has recently been actively studied. In the first lecture the experiments of Stern and his collaborators on molecular rays are briefly considered, and then an account is given of molecular spectra, the text here being illustrated by several useful diagrams. The parts played by the electronic, vibrational and rotational energies of the molecule in producing the spectra are clearly explained, and the importance of Raman spectra in deciding the natural frequency is emphasised. The second lecture dealt with a miscellaneous group of phenomena giving information about the mechanism of individual chemical molecular processes. The evidence for the existence of free radicals such as OH, NH, CH, etc., from spectroscopic results is considered in connexion with the energy of linkage. The chemical reactions of atomic hydrogen and atomic oxygen, the chemical evidence for the existence of free radicals given in the experiments of Paneth and F. O. Rice, chain reactions, predissociation, and three body collisions are topics dealt with in this lecture. Prof. Allmand's lectures will be found to constitute an admirable introductory survey of a highly interesting field of modern physical chemistry.

Astronomical Topics

Comet Peltier-Whipple. This was probably the brightest of the numerous comets that were observed in 1932. It was on the verge of naked-eye visibility at the end of August. *Astr. Nach.*, 5905, contains observations of it made by R. M. Aller of Lalin Observatory on twelve nights between August 25 and September 19; also drawings of the comet on August 27, 28, September 2 and 7. The tail is multiple; the main branch is triple and was traced to the length of a degree on August 28. Its position angle changed from about 300° on August 27 to about 330° on September 7. A short, but bright, tail was inclined at about 45° to the main tail, on the side of greater angle. The sketches show a coma about 3′ in diameter round the nucleus.

Mr. H. Jensen of Copenhagen finds 287·2 years as the period, and Mr. F. Koebcke of Poznan 286·8 years (Copenhagen Circulars 403, 404). Search in the catalogues does not show any previous apparition of the comet.

A determination of the light-curve of the comet has been published by K. Himpel (*Astr. Nach.*, 5913). It was of magnitude 6·7 on August 12, and slowly rose to a maximum of 6·3 on August 24: it then declined rapidly, being 7·7 on September 9. A very thorough investigation of its orbit, by Dr. Allan D. Maxwell (Publ. Univ. Michigan, vol. 5, No. 2) gives the period as 302·5 years. Comparison with other determinations suggests that this is unlikely to be more than some ten years in error.

Galactic Rotation. *Lick Observatory Bulletin* No. 448 contains an investigation on this subject by Miss Phyllis Hayford. It is necessary for this purpose to observe the radial velocities of distant objects. This investigation made use of a large number of spectrograms of stars in the Milky Way clusters, obtained with the 36-inch refractor; Dr. Trumpler took many of the plates, but all were measured by Miss Hayford. The clusters are all within 10° of the galactic plane, and are distributed fairly uniformly from galactic longitude 311° through 0° to 206°. 116 of the stars are of type *O5* to *B5*, 32 of type *B6* to *A2*, and 13 of later type. Their magnitudes range from 5·3 to 12·2; their adopted distances range from 940 to 3,680 parsecs.

As is to be expected, the solar motion relatively to these distant stars is higher than that derived from neighbouring stars; it is about 30 km./sec. The longitude of the galactic centre, 333°, agrees well with other determinations. The investigation confirmed the result of Dr. Plaskett and others that the interstellar calcium lines indicate a smaller distance than that of the stars in the spectra of which they are measured.

The distance of the galactic centre is found to be of the order of 1,800 parsecs from the sun, a much smaller distance than that found by Dr. Oort, which was about 6,000 parsecs. But the new distance, being derived from a limited number of objects, does not claim to be final.

Mutual Eclipses and Occultations of Jupiter's Satellites. Every six years the system of Jupiter is turned edgewise to us; at such times, numerous eclipses and occultations of one satellite by another take place. Until recently these phenomena were unpredicted, and in consequence they were very seldom observed. The Computing Section of the British Astronomical Association now makes predictions which are published in the B.A.A. Handbook; very many have been observed during the past twelve months. *L'Astronomie* for September contains an illustrated account of the occultation of IV by I observed by M. Schlumberger at Mulhouse on March 14, 1932; the occultation was very nearly total. The surface of IV is so much darker than that of I that it is easy to distinguish the two bodies when the discs are overlapping; at the maximum phase a very narrow segment of IV remains uncovered.

Prize Awards of the Paris Academy of Sciences

At the annual public meeting of the Paris Academy of Sciences, held on December 12, the prizes and grants for 1932 were awarded as follows:

Mathematics.—The Poncelet prize to Raoul Bricard, for his work in geometry; the Francœur prize to Henri Milloux, for his work on analytical functions.

Mechanics.—A Montyon prize to Jules Haag, for his work on chronometry; the Fourneyron prize to Maurice Roy for his work in applied mechanics; the Henri de Parville prize to Joseph Pérès, for his work in hydrodynamics; the Henry foundation to Dimitri Riabouchinsky for his work in aerodynamics and hydraulics.

Astronomy.—The Lalande prize to Abel Pourteau for his studies on the statistics of the double stars; the Damoiseau prize to Nicolas Stoyko for his studies on the measurement of time and allied problems; the Benjamin Valz prize to Jean Dufay for his work in astronomical photometry; the Janssen medal to Alexandre Dauvillier for his studies on the aurora polaris and allied phenomena; the La Caille prize to Eugène Antoniadi for his work on planets.

Geography.—The Delalande-Guérineau prize to Ernest Benoit for his theoretical works and geodesic operations in the field; the Gay prize to Emile Hasse for his calculations and discussions of geodesic and astronomical work carried out by the geographical service of the army; the Tchihatchef prize to Mme. Tardieu for her memoir on the ferns of Tonkin; the Binoux prize to the late Jules Hansen for his map of "L'Ancien Pays de Luxembourg".

Navigation.—The Navy prize to Pierre Malaval for his work on the resistance of materials; the Plumey prize to Henri de Leiris for his memoir entitled: "Experimental Researches on the Fatigue and Expansion of Steam Pipes".

Physics.—The L. La Caze prize to Eugène Darmois for the whole of his work; the Hébert prize to Charles Lavanchy for his work on the calculation and construction of high tension aerial cables; the Hughes prize to Emile Henriot for the whole of his work, especially on the radioactivity of the alkaline metals, the double refraction of compressed glass, high angular velocity cathode and magneto-cathode rays: the Clément Félix foundation to Gaston Dupouy for assisting his researches on magnetism.

Chemistry.—A Montyon prize (unhealthy trades) to Eugène Burlot for his work dealing with the safe handling of explosives and compressed gases; Raymond Horclois received a mention (1,500 francs) for his researches on the application of negative catalysis for extinguishing fires; the Jecker prize to the late Marc Bridel for his work in biological chemistry; the L. La Caze prize to Louis Hackspill for his researches in inorganic chemistry; the Cahours foundation between Paul Thomas and Paul de Graeve for work on fermentation; the Houzeau prize to Dimitri Ivanoff for his work on Grignard syntheses.

Mineralogy and *Geology.*—The Fontannes prize to Gustave Sayn for his palæontological work; the Victor Raulin prize to Louis Royer for his crystallographic work; the Demolombe prize to Paul Bertrand for his work in palæobotany.

Botany.—The Desmazières prize to René Morquer for his work entitled: "Morphogenic Researches on *Dactylium macrosporum*"; the Montagne prize to Gontran Hamel for his work entitled: "*Chlorophyceæ* of the French Coasts"; the de Coincy prize between Alfred Saint-Yves and the late John Briquet.

Anatomy and *Zoology.*—The Cuvier prize to Pierre Fauvel for his researches on annelids; the Savigny prize to Armand Billard for his work on the hydroids of the Bay of Suez; the Thore prize to Pierre de Boissezon for his memoir entitled: "Contribution to the Study of the Biology and Histophysiology of *Culex pipiens*".

Medicine and *Surgery.*—Montyon prizes to Paul Chevallier for his work on Hodgkin's disease, Philippe Lasseur and Mlle. Andrée Dupaix for their microbiological work, Victor Veau and Mme. Suzanne Borel for their work on palatal division; honourable mentions to Jean Albert Weil for his book on the poisons of the tubercle bacillus, to Grégoire Ichok for his book on work for the sick and infirm, and to Raoul Leroy and Georges Médakovitch for their book on general paralysis and malaria therapy; citations to Henry Chabanier and Carlos Lobo-Onell for their book on diabetes and to Charles Dubois and Noël Sollier; the Barbier prize to Stefan Jellinek for his researches on apparent death produced by electric shock; the Bréant prize (in equal parts) between Pierre Delanöe for his studies on the Moroccan spirochæte and Jean Sabrazès, Georges Jeanneney and René Mathey-Cornat for their book on bone tumours; the Godard prize to Mlle. Marthe Lamy for her book on gonococcic coxitis; the Mège prize to Henri Bouquet for his illustrated encyclopædia of medical knowledge; the Bellion prize to Edouard Imbeaux for his statistical and descriptive annual of the distribution of water and drainage in France, Algeria, Tunis, Morocco and French Colonies, Belgium, Switzerland and Luxembourg; the Baron Larrey prize to Jules Beyne, for his studies in aviators' sickness.

Physiology.—The Montyon prize to Henri Fredericq for his researches on the nerve control of the heart; the L. La Caze prize to Emile Abelous for his work in physiology, especially chemical physiology; the Pourat prize to Louis Rapkine for his work on the energetics of development, oxido-reduction potentials in cells and the chemical processes in the course of cell division; an honourable mention to Gabriel Laniez; the Martin-Damourette prize to Paul Fleuret for his work on the nutrition of animals; the Philipeaux prize to Paul Kucharski for his researches on audition.

History and Philosophy of Sciences.—The Binoux prize to Abel Rey, for the whole of his work on the history of science.

Works of Science.—The Henri de Parville prize between Jules Rouch, for his work on oceanography, meteorology and polar expeditions, and Georges Kimpflin, for his publications on artificial resin and the problem of heating.

Medals.—The Berthelot medal to Eugène Burlot and to Louis Hackspill.

General Prizes.—The prize founded by the State to Jacques Soula for the whole of his work; the Alhumbert prize to Francis Myard for his work on articulated systems; the Bordin prize to Gabriel Arnaud and Mme. Madeleine Arnaud for their treatise on plant pathology; the Lallemand prize to François Kiss and Jules Botár for their work on the physiology of the nervous system; the Serres Prize to Edouard Chatton for his work on the evolutive cycle and the determinism of sexuality in the Protozoa; the Vaillant prize to Maurice Gevrey for the whole of his work on partial differential equations; the Houllevigue prize to Albert Policard for his work in histophysiology and histochemistry; the Saintour prize to Albert Vandel for his work in zoology and general biology; the Lonchampt prize to Étienne Canals for his study on the physiological rôle of magnesium on plants; the Wilde prize to Ernest Chaput for his geological work; the Caméré prize to André Coyne for his work in civil engineering; the Gustave Roux prize to Pierre Bonnet for his thesis on sloughing, autotomy and regeneration in spiders with a study of the European Dolomedes; the Thorlet prize to Adolphe Richard; the Albert I of Monaco prize to Louis de Broglie for his researches in wave mechanics.

Special Foundations.—The Lannelongue foundation between Mmes. Cusco and Raphaël Rück; the Hélène Helbronner-Fould prize to Mme. Gustave Ferrié.

Prizes of the Grand Ecoles.—The Laplace prize to Jacques Desrousseaux; the L. E. Rivot prize between Jacques Desrousseaux, Georges Périneau, Jean Crussard and Jacques Aubriot.

Foundations for Scientific Research.—The Trémont foundation to Lucien Malassis for his inventions and work in connexion with calculating machines; the Gegner foundation to Wladimir Margoulis for his work in nomography with applications to aerodynamics and aviation; the Jérôme Ponti foundation to Jean Orcel for his work in metallography and opaque minerals; the Hirn foundation to Adolphe Buhl for his studies on the transformations and invariances of multiple integrals; the Henri Becquerel foundation to Henri Galbrun for his work on the calculus of probabilities and other mathematical researches; Mme. Victor Noury foundation between André Lwoff for his work on the physiology and nutrition of the Protozoa, Louis Corbière for his work in systematic botany and his contribution to the study of Norman flora; François Raoult for his analytical researches on rocks and Joseph Repelin for his geological work in Provence; the Henry Le Chatelier foundation to Paul Bastien for his researches on the alloys of calcium, niobium and gallium; the Roy-Vaucouloux foundation to Albert Brault for his studies on glycogen in the development of tumours, normal tissues and organised beings; the Charles Frémont foundation to M. and Mme. Albert Thomas for their researches on a photo-electrograph for the use of the blind.

THE LOUTREUIL FOUNDATION

1. *Researches on Definite Problems.*—5,000 francs to Marcel Brillouin for carrying out numerical calculations relating to the theory of dynamic tides; 2,000 francs to Paul Dechambre for continuing his researches on the physical properties of wool; 5,000 francs to M. and Mme. Joliot-Curie for travelling and other expenses in connexion with their work on physics at the Jungfraujoch station; 2,000 francs to Gustave Lesbouyries for the study of the diseases of birds due to filtrable viruses; 2,500 francs to Lucien Panisset and Goret for their researches on infectious anæmia of the horse; 5,000 francs to Marcel Petit for assisting his researches in comparative anatomy; 5,000 francs to Mme. Lucie Randoin for researches on vitamins; 2,000 francs to Victor Robin for researches on radiodiagnosis and radiotherapy in animals; 3,000 francs to Mme. de Vomecourt for assisting work to be done in the New Hebrides.

2. *Voyages and Explorations.*—15,000 francs to Camille Arambourg as a contribution to an expedition to eastern Africa; 9,000 francs to Auguste Chevalier as a contribution to a botanical expedition to Central Africa; 5,000 francs to Jacques Petit for an expedition to Madagascar.

3. *Purchase of Material.*—8,000 francs to the Lyons National Veterinary School for the purchase of a cinematograph apparatus; 3,000 francs to Augustin Mesnager for the purchase of an apparatus showing the distributions of strains in elastic solids; 5,000 francs to Albert Granger for the purchase of a furnace.

4. *Libraries.*—4,000 francs to the Toulouse National Veterinary School for its library; 6,000 francs to the Polytechnic School for its library; 10,000 francs to the Botanical Society of France for the establishment of a card catalogue of its library.

5. *Publications.*—5,000 francs to the National and University Library of Strasbourg for preparing and printing a catalogue of periodicals; 4,000 francs to the Astronomical Observatory of Zò-Sè, for its publications; 9,000 francs to the National Acclimatisation Society of France for the publication of a book by (the late) Rollinat on the biology of the reptiles of central France; 5,000 francs to the widow of Jean Thomas for the publication of a book dealing with his work resulting from the expedition between the Congo and Lake Tchad.

Instability of Liquid Surfaces

THE problem of the instability of the 'liquid surface' separating two media has fascinated and attracted many investigators but the complexity of the phenomenon as seen in the laboratory and in everyday life, as well as the difficulty of the mathematics, have made progress very slow in the direction of a solution.

A reference to the instability of the surface of separation between two fluids is first found in a paper by Helmholtz[1], and Kelvin[2] in an investigation of the influence of wind on waves in water, supposed frictionless, discussed the conditions under which a plane surface of water becomes unstable. Adopting a suggestion due to Kelvin, Rayleigh[3] investigated the instability of such a surface and obtained results which by now are classical. To a first approximation, the system is unstable for all wave-lengths and the amplitude of an initial displacement of the form $y = a\cos kx$ increases exponentially with the time. The first approximation, however, shows no tendency in the direction of the formation of vortices, but a recent investigation by Rosenhead[4] shows that the tendency towards rolling up is apparent if account is taken of second order terms in the approximation. In order to obtain the ultimate form of the surface of discontinuity, Rosenhead departs from the Rayleigh method and by means of an approximate numerical process demonstrates the formation of vortices. This method, however, does not discover the wave-length which ultimately becomes dominant in the system and so fixes the distance between successive vortices.

Banerji and Ghatage have now investigated the motion of the 'liquid surface' separating two portions of the same medium which are at different temperatures.[5] The account of the investigations is illustrated by a number of excellent photographs showing the rolling up of the surface of discontinuity into vortices, and the separate convolutions can easily be seen. There are also several tables of numerical results which can be used when we have a complete theory capable of explaining the rolling up and of giving the value of the dominant wave-length or wave-lengths.

Previous investigators, theoretical and experimental, seem to have concentrated on discussing the surface separating two streams of equal temperature but differing velocities. Banerji and Ghatage supplement the existing information by investigating the effect of a difference in temperature in addition to the difference in velocity. The results, some of which might have been expected on general grounds, are interesting. A discontinuity in temperature alone, and hence a discontinuity in density, was introduced by making a cylindrical or rectangular column of water in a large tank differ in temperature from the adjoining fluid. Discontinuities in velocity as well as in density were produced by making two streams of water meet at various angles under different thermal conditions.

In all cases the initial surface of separation was in a vertical plane and not, as in most previous work, in a horizontal plane. This makes the basic motion unsteady, so that the surface of discontinuity has a tendency to change its position quite apart from its inherent instability. The instability, however, was quite apparent. The surface assumed a wave pattern, each crest or trough took up the form of a breaker and rolled round itself, thus producing a vortex and a series of spiral-shaped three-dimensional vortices was formed. "In the direction of motion the vortices showed a progressive increase in dimensions and number of convolutions. The greater the difference of temperature at the surface of discontinuity, or the greater its slope, the smaller was the diameter of the vortices. For very small difference of temperature the vortices had enormous diameters. The greater the difference of temperature at the surface of discontinuity, the more rapidly did the vortices develop." The shape of the surface of discontinuity was obtained by colouring various parts of the liquid and by photographing the visible stream lines in horizontal and vertical sections. The paths of the particles at the surface of discontinuity were also photographed but the actual material used to make the motion visible probably has some small influence on the paths of the particles of fluid.

L. ROSENHEAD.

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[1] Helmholtz, *Phil. Mag.*, **36**; 1868.
[2] Kelvin, *Phil. Mag.*, **42**; 1871.
[3] Rayleigh, *Proc. London Math. Soc.*, **10**; 1879.
[4] Rosenhead, *Proc. Roy. Soc.*, A, **134**; 1931.
[5] Banerji and Ghatage, *Indian J. Phys.*, **7**; 1932.

Population Density and Egg-Laying in Flies

IN a paper of much interest, Prof. Raymond Pearl has made a study of the influence of density of population upon egg production in Drosophila (*J. Exp. Zool.*, vol. 63, No. 1), which is a continuation of his investigations on the biological relations underlying the growth of populations.

The flies were placed under standard conditions and deposited their eggs on an agar surface of fixed area where they could be counted. In general, the higher the number of pairs of flies in a bottle of given size the smaller the number of eggs laid per individual. This result, obtained with different populations of flies, was then repeated by comparing the egg production of the same flies when kept for alternating twenty-hour periods under conditions of high or low population density. More than 100,000 eggs were counted in these experiments.

The decrease in the rate of egg production with increasing density of population is described by the same type of mathematical equation as that which relates the density of a gas to the mean free path of its molecules. From numerous observations of the behaviour of single flies under isolated conditions, they are found to go through regular cycles of feeding, walking or flying, resting and cleaning their legs. These rhythms are easily disturbed and the flies are found to be extremely sensitive to slight environmental disturbances. The denser the population the more they interfere with each other's rhythmic activities, thus decreasing the amount of food intake and oviposition and increasing their muscular activity. That the area of agar surface for feeding and egg-laying, and not the volume of air, is the significant factor, was shown by comparing the oviposition in bottles of twice the size but with the same area of agar.

In the same journal, Dr. Alpatov has investigated egg production in vestigial- and long-winged flies under different conditions of development, the former showing much lower productivity. The influence of temperature and underfeeding in the larval stage were investigated. At a low temperature, egg production begins earlier. Underfeeding reduces productivity, and a negative correlation is found between length of life and egg production.

Mycorrhiza on Conifer Roots

A VERY thorough study of the root system of young conifers has been made by Dr. E. V. Laing for the Forestry Commission, and an account of this work is published by the Commission as Bulletin 13 under the title of "Studies on Tree Roots" (1932). This account contains an interesting contribution to our knowledge of mycorrhiza on these roots.

There are two forms of mycorrhiza; the ectotrophic, in which the fungus grows mainly on the surface of the root, and the endotrophic, in which it penetrates the cells of the cortex practically as far inwards as the endodermis. Dr. Laing points out that whilst both forms may occur on the same tree yet, on the whole, the ectotrophic type is common in pine, spruce and larch, whilst the endotrophic type is characteristic of *Cupressus*, *Thuya* and *Taxus*. This distribution of the fungus correlates in an interesting manner with differences in cortical structure. In the first group of conifers the cortical cells have thin walls and contain little starch; in the second group characteristic girdle thickenings occur on the walls of the cortical cells and these cells usually contain starch; this is the type of cortex which is usually invaded by the fungus.

Dr. Laing's investigations also point to the significance of aeration conditions in the soil and manurial treatment in determining whether fungus and root system shall enter into the characteristic mycorrhizal relation. The conditions favouring mycorrhizal infection of the roots also favour vigorous growth of the young tree, so that it remains difficult to assess the significance of the fungus partner in the development of the tree.

A progress report upon investigations into the same problem was presented to Section K (Botany) of the British Association at the York meeting by a committee, of which Dr. M. C. Rayner acted as secretary and Mr. F. T. Brooks as chairman. The work initiated under this committee is now being continued with the aid of a grant from the Forestry Commission, and the results of this work will doubtless be published more fully by Dr. Rayner in due course.

In the report it is stated that soil innoculation experiments have now provided convincing evidence of a direct relation between mycorrhiza formation and satisfactory seedling growth in the case of three species of pines, Scots pine, Corsican pine and maritime pine. From the practical side, the work of the committee has been devoted largely to an examination of the effect of the addition of humus to the nursery beds of tree seedlings, with the view of improving root development and mycorrhizal infection.

University and Educational Intelligence

Cambridge.—The Sir William Dunn readership in biochemistry has become vacant by the resignation of Prof. J. B. S. Haldane. Candidates for the readership, the stipend of which is £600 a year, are requested to communicate with the Vice-Chancellor on or before February 18.

Edinburgh.—The Cameron prize for advance in knowledge in practical therapeutics for 1933 has been awarded to Dr. George F. Dick and Dr. Gladys H. Dick, of the John M'Cormick Institute for Infectious Diseases, Chicago, jointly, in recognition of their work on the etiology and treatment of scarlatina.

London.—Prof. L. N. G. Filon, Goldsmid professor of applied mathematics and mechanics in the University (University College), has been elected Vice-Chancellor for the remainder of the year 1932–33 in succession to the late Mr. J. L. S. Hatton.

The title of reader in experimental physiology in the University has been conferred on Mr. H. P. Gilding, in respect of the post held by him at University College.

Mr. Frank Arnold Greene has been appointed a fellow of King's College. Mr. Greene was a student in the faculty of engineering from 1891 until 1894; he is treasurer of the Institution of Chemical Engineers, and a member of the College Chemical Engineering Committee.

In the eighth annual report to the Court of Governors of the London School of Hgyiene and Tropical Medicine, Keppel Street, W.C.1, various changes in the personnel of the Court and of the Board of Management are recorded. Sir Austen Chamberlain becomes chairman of the Court in succession to Sir Holburt Waring, who becomes honorary treasurer to the Board of Management. The minimum annual expenditure to which the School is committed is £60,000, towards which there is a reasonably assured income of £50,000, leaving a deficit of £10,000 to be met by subscriptions and donations. A grant of 25,000 dollars for 1932 was received from the Rockefeller Trustees. In the report by the Dean, Prof. W. W. Jameson, on the year's work of the School, the teaching and research activities are surveyed, examination results are recorded, and a list of papers published by members of the staff is appended. It is announced that the Prudential Assurance Company has endowed for a term of seven years the chair of public health, which will henceforth be known as the "Prudential Chair of Public Health". A syllabus containing full particulars of the post-graduate instruction in preventive medicine given at the School is issued and may be obtained on application to the Dean.

Calendar of Nature Topics

The First 'Buchan Cold-Spell'

February 7–14.—In 1869 the late Dr. A. Buchan, from an analysis of observations of temperature in Scotland, concluded that "there are certain periods more or less well-defined, when the temperature, instead of rising, remains stationary or retrogrades; instead of falling, stops in its downward course, or even rises; and at other times falls or rises respectively for a few days at a more accelerated speed than usual". Buchan attributed these variations to the alternations of cold and warm air currents, but several other more or less fanciful explanations have been put forward by different authors, all of whom took the reality of the 'spells' for granted. A recent investigation has shown, however, that in London since 1870 there has been no definite tendency for temperature to be abnormally low on the dates of Buchan's cold spells, the period February 7–14, for example, having been warm as often as it was cold.

Fish Culture

"Feb. 9th, 1863.—Eggs of first lot of Rhine salmon hatched out in my bath." (Buckland, Diary.) The middle of last century saw a great revival in European countries of the ancient art of pisciculture. The work of Coste and the establishment by the French Government in 1848 of a hatchery at Huningue near the Rhine and Rhône Canal led to a widespread interest in salmon and trout rearing. In 1853, Dr. Garlick of Ohio first bred fish artificially in the United States, and in the same year the well-known Stormontfield establishment on the Tay came into being. In England, Buckland, later H.M. Inspector of Fisheries, took up the idea with great enthusiasm. During the past eighty years, fish culture has developed commercially on a very large scale especially in America.

Partridge Disease

The partridge season which has just closed will be memorable for the prevalence and the investigation of partridge disease. Beginning noticeably in the autumn of 1930 the disease spread widely and caused heavy mortality. Examples of its incidence in 1931 on various estates are—in Hampshire of a stock of young and old birds numbering 3,000, 2,000 perished, in Norfolk 4,200 perished out of 5,000, in Suffolk 2,600 out of 3,467, in Derbyshire 2,200 out of 2,500, in Nottinghamshire 10,100 out of 12,000. *Country Life* appointed a committee under the chairmanship of Major M. R. Portal to investigate the disease and the findings have recently been published under the editorship of Major Portal and Dr. W. E. Collinge. While partridges have several internal parasites, the cause of the widespread disease is a nematode worm, *Trichostrongylus tenuis*, a near relative of the agent of grouse disease, *T. pergracilis*. Like the latter, the partridge strongyle lives in the caeca, causing blockage and the production of septic conditions. Exceptionally, as many as 12,226 and 10,500 individuals have been found in single birds, but a count of 1,000 to 2,000 marks a more usual infestation. In the caeca the worms pair and after the eggs are laid they pass out with the fæces and develop into larvæ which make their way up the damp stems of grasses, clovers and such like. With vegetable matter they are swallowed by the partridges and the cycle begins again in the bird's intestine. The Committee has reached the conclusion that predisposing causes of the spread of the disease were interbreeding, the carrying of large winter stocks, an insufficiency of food, and peculiarly unfavourable meteorological conditions.

Fluctuations of Partridge Numbers

It is notorious that the numbers of partridges on an estate may show great changes from year to year, and periods of great plenty and of great scarcity seem to follow each other in cycles. In the game book of one of the great landowners in Britain, ignoring the years before partridge driving began (about 1845), there are enormous swings of the partridge pendulum: in 1864, 634 birds were shot, the numbers rose to a peak in 1870 with 3,741, but by 1879 they had fallen, gradually, to 359; another steady rise, and in 1887, 5,360 were shot and in 1896, 5,478. Such totals have not since been reached on these estates and later figures suggest a tendency for the annual bag to become smaller. The complicated factors of weather, food, natural enemies and disease, which influence the numbers from year to year, have not yet been resolved, but there can be little doubt that the modern trends of agriculture and transport are likely to make permanent inroads upon the partridge population. The partridge is a bird of cultivated land, and the intensive cultivation which ploughs a field to its very borders and replaces hedgerows by fences, has destroyed the rough herbage which was a favoured nesting site. Extensive turning of crop land into pasture has removed a source of food, as well as protective cover for the nests and young, and grass conceals the fine grit essential for the grinding of food, which the plough laid bare. New forms of road surface have done away with another source of grit, and have banished favourite dust baths, also reduced by the grass lands. The cleaning up of the roadsides and the removal of hedges have removed former nesting places, and the fast traffic of the roads is directly responsible for a certain amount of mortality. In face of such adverse factors, it would be surprising if the stock of partridges were not to decline, unless steps are taken to minimise their influence. This is a very simple illustration of the way in which the native fauna of the country may be undergoing modification.

Societies and Academies

LONDON

Royal Society, Jan. 26. J. Z. YOUNG: Comparative studies on the physiology of the iris. (1) Selachians (second paper)—*Uranoscopus* and *Lophius*. The sphincter iridis muscle of *Scyllium*, *Mustelus* and *Trygon* contracts in direct response to illumination and is not under nervous control. The iris of *Lophius piscatorius* and also that of *Uranoscopus* is capable of rapid movements under nervous control, the oculomotor dilating and the sympathetic constricting the pupil. S. G. PAINE, F. L. LINGOOD, FREDA SCHIMMER and T. C. THRUPP: The relationship of micro-organisms to the decay of stone. Three groups of bacteria have been distinguished. In the first group are included common organisms of air, soil, and water. These organisms are capable of living on a variety of food materials, and in their metabolism acid substances are formed as waste products; these acids, even when the food supply is merely the small amount of organic matter present in rain water, can dislodge carbon dioxide from its combination with calcium in the stone. In the second group some confirmation is to be found of the view of Marsh that nitrifying bacteria can be responsible for stone decay. In the third group are the sulphur-oxidising organisms which have been found closely associated with white incrustations of sodium and calcium sulphate on the surface of decaying stones. W. J. ELFORD: The principles of ultra-filtration as applied to biological problems. The several factors concerned in the general process of filtration have been investigated, using typical disperse systems—colloidal dyes, metal sols, protein solutions and suspensions of bacteria and viruses. The relationship between the size of retained particles and the estimated pore sizes of membranes is also discussed. The fact that, for colloidally dispersed systems, the pore-size of the limiting membrane is definitely greater than the size of the retained particle, even under optimum filtration conditions, is in accordance with theoretical expectations. The particle sizes of suspensions, estimated from filtration experiments with carefully graded collodion membranes, agree well with the values obtained by other methods. The method of analysis adopted has proved of great value in virus studies.

PARIS

Academy of Sciences, Dec. 19 (195, 1185-1335). MARCEL BRILLOUIN: Multipolar spherical non-antipodal functions. Recurrences. L. CAYEUX: The existence of a phosphate containing spicules of Calcisponges in the Ordovician of Wales. MARIN MOLLIARD: Experiments permitting an explanation of the attenuation of the chlorophyll shown by parasitic green plants. Results of experiments comparing the growth of the radish in a medium of carrot decoction and in Knop's fluid containing saccharose. About ten times as much chlorophyll appeared in the leaves of the plants grown in the latter medium as in leaves from plants grown in the carrot decoction. L. BLARINGHEM: A case of atavism which appeared in a strain of the opium poppy. One example, in 5,000 strictly isolated individuals, of reversion to a type known three centuries ago, showed a change to white petals bordered with red. CHARLES ACHARD and AUGUSTUS BOUTARIC: Some physico-chemical researches on suspensions prepared starting with proteins separated from serum by the so-called acetone method. From the results of the experiments described, the authors conclude that the separation of the proteins by the acetone method of Piettre and Vila causes no changes in the protein molecules. R. FOSSE, P. DE GRAEVE and P. E. THOMAS: A new plant principle: uric acid. Uric acid has been found in a mould but, according to Czapek, is not present in the higher plants. Using a technique given in detail, the authors have proved this acid to be present in various plants in quantities ranging from 0·003 per cent in *Glycina soja* to 0·025 per cent in *Melilotus officinalis*. CHARLES CAMICHEL: Transitory [hydraulic] regimes. M. GIGNOUX and L. MORET: The geological structure of the base of the Flysch sheet of Embrunais in the Ancelle valley, near Gap (Hautes-Alpes). JULES RICHARD: The use of the Cattaneo wave pump for utilising the movements of the sea. Diagram and description of the pump, which has raised 495 litres an hour to a height of 51 metres. L. LÉGER and T. BORY: The parasitism of an *Oscillaria* in the intestine of the carp. LALAN: The asymptotic transformations of minimal curves. PAUL MONTEL: A theorem of Rouché. GEORGES BOURION: Ultra-convergence in certain series of analytical functions. J. FAVARD: The topological structure of rectifiable contina. A. KOSTITZIN: A geological application of differential equations. D. BELORIZKY: The representation of certain functions by particular series of polynomials. J. GRANIER: The influence of vibration on the rate of watches. P. DUPIN and M. TEISSIÉ-SOLIER: The vortices produced by obstacles revolving round an axis parallel to the general direction of flow. Reproductions of a photographic film are given showing the changes in the shapes of the vortices. MAX SERRUYS: The determination of some physical characters of detonation showing its local character. A. GREBEL: A diagram representing the true phenomena of compression, combustion and expansion in high speed motors. V. G. SIADBEY: The determination of meteoric trajectories. HENRI MINEUR and ANDRÉ MACHIELS: The distribution of the absorbing galactic material. F. LINK: The photometric study of the partial eclipse of the moon on September 14, 1932. Tabulated results of observations made at the Pic du Midi Observatory (height 2,860 metres). ROLIN WAVRE: The polydromes of the Newtonian potentials of a family of homogeneous bodies. A. LABARTHE and M. DEMONTVIGNIER: Methods of measuring and recording rapidly variable pressures. A ray of light falls on a mirror forming part of the wall of the space in which the pressure is to be measured: the reflected ray falls on a photoelectric cell, the currents from which are amplified in the usual manner. Successful applications to studying the pressure changes inside the cylinder of an internal combustion motor are described. JAMES BASSET: The realisation of a chamber for experimenting at any temperature under permanent gaseous or liquid pressures up to 15,000 kgm./cm.^{2} with visual observation of the phenomena and with photographic or cinematographic registration. PIERRE VERNOTTE: The natural convection of heat in air when the heating is very small. The comparison of the limiting value of the convectance with the thermal conductance of the medium. PIERRE DAVID: The radiation of the radiotransmitter of the Eiffel Tower. A study of the radiation shows that the metallic parts of the Tower are the seat of important currents, modifying the radiation in an unexpected manner. HORIA HULUBEI: Demonstrating multiple Compton diffusion. PAUL WOOG and RENÉ SIGWALT: The use of the Duboscq colorimeter for the definition of colours by analysis in different parts of the spectrum. A. NAHERNIAC: The study of a phenol–OH band in the near infrared. T. N. PANAY: An integral radiator (black body) of electrically heated carbon. The apparatus described and figured can be worked at temperatures of the order of 2400° K. It embodies a special device to obviate the necessity of the electrical conductors being sealed into the glass container. Q. MAJORANA: The confirmation of the existence of a new photoelectric phenomenon. C. JAUSSERAN: The action of a developer on latent images of different ages. R. COUSTAL and H. SPINDLER: The electrolysis of dry liquid ammonia. GEORGES FOURNIER and MARCEL GUILLOT: The absorption of the β-rays by matter. The relation between absorption and atomic number given in a previous note is now shown to hold for platinum and lead. P. LECOMTE DU NOÜY: Improvements to the hydrogen electrode for the measurement of hydrogen ion concentration in solutions. A method by means of which the platinising and hydrogenation of the electrode can be dispensed with. A. LALANDE: A new cryoscopic method. R. TREHIN: The influence of temperature on the absorption of aqueous solutions of hydrochloric acid in the extreme ultra-violet. The coefficient of molecular absorption is a function of three variables: wave-length, concentration and temperature. J. HERENGUEL and G. CHAUDRON: The sublimation of magnesium in a vacuum and casting in an atmosphere of argon. By means of the apparatus described and illustrated, ingots of magnesium of 26 kgm. can be prepared. PICON: Preparation and properties of thallous thiocarbonate. A specific reaction of thallium. This compound is easily prepared by adding carbon disulphide to thallium sulphide in alkaline solution. It is a vermilion red precipitate, formed in very low concentrations of thallium, and serves as a means of identifying thallium. HENRI LAFUMA: Hydrated bicalcium aluminate. FIRMIN GOVAERT: The estimation of the halogens in organic substances by the sodammonium method. The estimation of fluorine in some organic compounds. The method is shown to be widely applicable. ROBERT CAMBIER and LUCIEN LEROUX: The estimation of organic nitrogen in the presence of nitrates by Kjeldahl's method. The nitric acid is first removed by acidifying with sulphuric acid and distillation in a vacuum at a low temperature. R. SUTRA: The structure of starch. TIFFENEAU: Molecular transpositions in the cyclohexane series: passage to the cyclopentane series. MME. M. GUAISNET-PILAUD: The phenylmethyl-ethyl betaines and the geometrical stereoisomerism of organic compounds containing pentavalent nitrogen. R. PAUL: The stability of the oxygen linkage in the tetrahydrofuryl derivatives. M. BATTEGAY and L. DENIVELLE: The aryl-chlorsulphinates and aryl sulphites. Criticism of a recent paper by P. Carré and D. Liebermann. E. AUBERT DE LA RÜE: Preliminary study of the geology of the Saint-Pierre and Miquelon Islands. R. DELABY, R. CHARONNAT and M. JANOT: The radioactivity of the waters of the Ballon d'Alsace. ALPHONSE LABBÉ: The hydrogen ion concentration and rhythm of the tides. R. GUIZONNIER: The diurnal component of the gradient of electric potential at Val-Joyeux. The variations of its phase and amplitude. ANDRÉ ALLIX: The progressive darkening of the Lyons atmosphere. The visibility of the Alps. A comparison of the periods 1894–1900 and 1925–1931 shows a distinct decrease in the transparency of the atmosphere. Paul Bertrand: Observations on the Saalfeld *Cladoxylon*. St. Jonesco: The movements and growth of the flower peduncles of *Ipomœa purpurea*. Marcel Lefèvre: The structure of the membrane of *Euglena* of the *Spirogyra* group. Pierre Chouard: The diversity of types of seedlings in *Allium*. Michel Gračanin: Ion concentration as a factor in resorption. H. Colin and M. Quillet: The jelly of the egg of *Phallus impudicus*. J. Chaze: The exudation of the alkaloids of *Lupinus albus*. Mlle. C. Bourdouil: The relation between the synthesis of starch and the weight of the seeds in hybrids of *Pisum*. Robert Lemesle: New researches on *Scabosa Succisa* attacked by *Fusarium anthophilum*. Mme. F. Franck and D. Auger: The cinematographic analysis of the movements of protoplasm in relation with the electrical variation in stimulation in *Nitella*. Charles Pérez: Intersexual anomalies in hermit crabs. Mme. Jeanne Henri-Heldt: The male genital apparatus of North African shrimps of the family of Penæidea. Mme. L. Randoin and H. Simonnet: The constitution of an artificial diet for the purpose of long-period experiments on the relations between nutrition and the phenomena of growth, subsistence and especially reproduction. Raymond-Hamet: The action of tyramine on the excitability of the cardiac pneumogastric and the influence of this amine on the effects of nicotine. Mlle. M. L. Verrier: Comparative physiology of the cones and rods. Indications given by behaviour.

Forthcoming Events

Monday, Feb. 6

University College, London, at 5.30.—H. W. B. Joseph: "Space Perception" (succeeding lectures on Feb. 13 and 20).

Society of Engineers, at 6—(at the Rooms of the Geological Society, Burlington House, W.1).—J. D. Hawort: Presidential Address.

Royal Geographical Society, at 8.30.—Capt. Ejnar Mikkelsen: "The Blosseville Coast of East Greenland".

Tuesday, Feb. 7

King's College, London, at 5.30.—Dr. F. T. Chapman: "Induction Motor Theory" (succeeding lectures on Feb. 14 and 21).

Thursday, Feb. 9

Bedford College, London, at 5.15.—"Contemporary Developments in Science." Prof. E. T. Whittaker: "The Development of the Concept of Energy in the Twentieth Century".

Friday, Feb. 10

Royal Astronomical Society.—Dr. H. Knox-Shaw (Presidential Address): "The Distance and Motions of the Extra-Galactic Nebulæ".

Royal Institution, at 9.—Prof. A. V. Hill: "The Physical Nature of the Nerve Impulse".

Official Publications Received

GREAT BRITAIN AND IRELAND

Department of Scientific and Industrial Research. Report of the Forest Products Research Board; with the Report of the Director of Forest Products Research for the Year 1931. Pp. vii + 51 + 8 plates. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

Journal of the English Folk Dance and Song Society. Vol. 1, No. 1, December. Pp. vii + 72. (London.)

Proceedings of the Royal Irish Academy. Vol. 41, Section A, No. 4: Multiply Charged Large Ions. By J. J. Nolan and J. G. O'Keeffe. Pp. 25–40. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 18, No. 2, January. Pp. 435–758. (Plymouth.) 17*s*. 6*d*. net.

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1931. Part 2. Pp. v + 166 + 4 plates. (London: H.M. Stationery Office.) 3*s*. net.

Proceedings of the Society for Psychical Research. Part 128, Vol. 41, January. Pp. 89–119. (London: Society for Psychical Research.) 4*s*.

Department of Scientific and Industrial Research: Water Pollution Research. Summary of Current Literature. Vol. 6, No. 1, January. Abstracts Nos. 1 + 120. Pp. 36. (London: H.M. Stationery Office.) 2*s*. net.

OTHER COUNTRIES

Reports of the Institute for Science of Labour, Kurasiki, Japan. No. 1: An Essay on the Population Problem of Japan in the Light of Social Biology. By Dr. Gito Teruoka. Pp. ii + 19. 50 sen. No. 2: On the Influence of Factory Work on Psycho-Physical Function. By Dr. Hoken Kirihara. Pp. ii + 9. 25 sen. No. 3: Studies on the Influence of the Day and Night Shift System upon the Physiological Functions of Labourers. By Dr. Tomoyoshi Ishikawa. Pp. ii + 11. 30 sen. No. 4: On the Variations of the Body Weight of Young Working Girls employed in Day and Night Shift Work. By Dr. Takatsugu Yagi. Pp. ii + 19. 50 sen. No. 5: The *Ama* and her Work; a Study of the Japanese Female Diver, Part 1. By Dr. Gito Teruoka. Pp. ii + 12. 30 sen. No. 6: A New Method of Determining the Center of Gravity of the Human Body in the Erect Standing Position. By Dr. Misao Okuyama. Pp. ii + 9. 30 sen. No. 7: The Development of Intelligence in relation to Socio-economic Status; with Special Reference to the Intelligence of Children of the Labouring Classes. By Dr. Hoken Kirihara. Pp. ii + 22. 50 sen. No. 8: Oxygen Consumption during Mental Work. By Dr. Syûzô Matusima. Pp. ii + 11. 25 sen. No. 9: Physiological Standards and Occupational Characteristics of Bodily Functions of the Japanese. 1: Vital Capacity. By Dr. Tomoyosi Isikawa. Pp. ii + 13. 25 sen. No. 10: Frauenarbeit unter biologischen Gesichtspunkt. By Dr. Gito Teruoka. Pp. ii + 48. 1.00 yen. No. 11: A Critical Study on the Method for Estimating the Nutritional State and Physical Capacity of the Human Body. Part 1: Trophical State, First Report. By Dr. Takatsugu Yagi. Pp. ii + 12. 25 sen. No. 12: Physiological Standards and Occupational Characteristics apparent in Bodily Functions of the Japanese. 2: Power of Grip measured by Dynamometer. By Dr. Tomoyosi Isikawa. Pp. ii + 14. 30 sen. No. 13: i. An Experimental Study on Working Speed of Post-card Sorting, by Dr. Yosio Ueno; ii. Physiological Study on Working Speed of Post-card Sorting, by Dr. Gito Teruoka and Dr. Yosio Ueno. Pp. ii + 14. 30 sen. No. 14: Functional Periodicity; Experimental and Statistical Studies on Rhythm in Working Capacity of Women. By Dr. Hoken Kirihawa. Pp. ii + 53. 1.00 yen. (Kurasiki.)

Baltische Geodätische Kommission. Sonderveröffentlichung No. 2: Bestimmung der Längenunterschiede der Landeszentralen im Jahre 1929. 1: Das Beobachtungsmaterial. Pp. iv + 229. (Helsinki.)

The Quarterly Journal of the Geological, Mining and Metallurgical Society of India. Edited by K. K. Sen Gupta. Vol. 4, No. 2, November. Pp. 29–67. (Calcutta.) 6 rupees.

Institut de France: Académie des Sciences. Annuaire pour 1933. Pp. 404. (Paris: Gauthier-Villars et Cie.)

Survey of India. Professional Paper No. 27: Gravity Anomalies and the Structure of the Earth's Crust. By Major E. A. Glennie. Pp. v + 35 + 10 plates. (Dehra Dun: Survey of India.) 1.8 rupees; 2*s*. 6d.

Publications of the Dominion Astrophysical Observatory. Vol. 6, No. 5: The Galactic Rotation Effect in some Late Type Stars (Second paper). By R. O. Redman. Pp. 27 + 48. (Ottawa: F. A. Acland.)

Canada: Department of Mines: Mines Branch. Investigations of Mineral Resources and the Mining Industry, 1931. (No. 727.) Pp. ii + 153. (Ottawa: F. A. Acland.)

First Annual Report on Cacao Research, 1931. Pp. 43. (Trinidad, B.W.I.: Imperial College of Tropical Agriculture.) 1*s*.

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft. 113 Jahresversammlung vom 6 bis 8 August 1932 in Thun. Pp. 510 + 68. (Aarau: H. R. Sauerländer et Cie.)

Western Australia. Annual Progress Report of the Geological Survey of Western Australia for the Year 1931. Pp. 20. (Perth: Fred. Wm. Simpson.)

Journal of the Royal Society of Western Australia. Vol. 17, 1930–31. Pp. xi + 190. (Perth.) 21*s*.

Meddelelser fra Kommissionen for Danmarks Fiskeri- og Havundersøgelser. Serie Plankton, Bind 2, Nr. 3: On the Food of the Herring in Icelandic Waters. By P. Jespersen. Pp. 34. (København: C. A. Reitzels Forlag.)

New Zealand: Department of Lands and Survey. Annual Report on Scenery Preservation for the Year ended 31st March, 1932. Pp. 8. Annual Report on Public Domains and National Parks of New Zealand. Pp. 10. (Wellington, N.Z.: W. A. G. Skinner.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 4, No. 12, Décembre. Pp. 621–644 + xx. (Prague: Regia Societas Scientiarum Bohemica.)

Proceedings of the American Academy of Arts and Sciences. Vol. 67, No. 7: Further Studies on the Fauna of North American Hot Springs. By Charles T. Brues. Pp. 185–303. (Boston, Mass.) 1.85 dollars.

U.S. Department of the Interior: Office of Education. Annual Report of the Commissioner of Education for the Fiscal Year ended June 30, 1932. Pp. iv + 35. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 82, Art. 5: New Fossil Fresh-Water Mollusks from Ecuador. By William B. Marshall and Edgar O. Bowles. (No. 2946). Pp. 7 + 1 plate. (Washington, D.C.: Government Printing Office.)

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Rubber Research

FREQUENT reference has been made in our columns to the importance of the relations between the State and industry in regard to research. Abundant evidence has been quoted to show that research on materials, methods of manufacture, and the properties of finished products not only benefits the industry concerned but also, directly and indirectly, the whole nation. Recognition of this common interest in research was shown by the grant in 1916 of a special fund to initiate and encourage co-operative research in Great Britain, and by the continuation of grants to the industrial research associations, which came into existence as a result of this policy, long after the end of the trial periods originally contemplated.

We are reminded of this community of interest by the announcement that the thirteen years' partnership between the rubber manufacturing industry and the State, through the Department of Scientific and Industrial Research, is to be dissolved unless assurance is immediately forthcoming that the finances of the Research Association of British Rubber Manufacturers can be established on a stable and adequate basis. The situation demands attention particularly because the fate of the Association now appears to rest with the House of Commons and possibly with the Government.

The Association, initiated in 1919 with fifteen members, has now grown to a membership of eighty-six firms, and is supported in addition by ninety-five subscribing firms and institutions interested in rubber but not qualified as actual manufacturers for full membership. A summary of the twelfth annual report was given in our columns (NATURE, 129, 695, May 7, 1932), and from this it is evident that the Association has made itself increasingly useful, not only to its own members, but also to other trade and research associations and Government departments.

In recent years the financing of the Association has become increasingly difficult, partly owing to the industrial depression and partly owing to the constitution of the industry, consisting as it does of a large number of firms varying greatly in size. Some of the larger units, which have supported the Association both financially and scientifically from the beginning, are capable of carrying out research economically in their own factories and therefore take the view that they cannot continue to finance the Association in the common interest, except under some scheme by which all members of the industry contribute on a proportionate scale. To this end the Association has prepared a scheme by which it would be financed by the proceeds of a levy of one forty-fifth of a penny per lb. on all raw rubber imported into Great Britain, thus spreading the burden uniformly over the units of the whole industry in proportion to their rubber consumption. This levy would secure an annual income to the Association of about £15,000. The scheme has been accepted by the majority of the firms in the industry and approved by the principal trade associations.

The financing of research or development by a levy on a basic material is not without precedent. The Cotton Industry Act of 1922 provides for the encouragement of cotton-growing in the British Empire by a levy on raw cotton; there is a cess on exported rubber for the upkeep of raw rubber research in Ceylon; and there is a levy on coal by which the Miners' Welfare Fund is financed in Great Britain. The idea of a levy for the support of a research association has also been considered favourably by more than one Parliamentary Committee. In its Final Report, the Balfour Committee on Industry and Trade stated:

> "We have watched with interest and sympathy the steps taken by the rubber industry to secure the necessary funds for the operation of its research Association through a small levy on imported rubber. We hope that this scheme will receive legislative sanction, and that it may serve as an example to other industries to adopt measures, suited to their special conditions, for placing the finances of their research Associations on a permanently satisfactory basis."

Again, the Committee on New Industrial Development stated in its report:

> "We do not consider that any general powers should be taken to enforce compulsory levies for the support of research Associations. Should an industry, however, succeed in working out a practicable scheme involving a compulsory levy for the support of a research Association, which it can show commands the support of a substantial majority of the industry, including the larger concerns, we consider that the Government should be ready to assist the Industry in obtaining the necessary Parliamentary powers."

The proposal for a levy in this case is embodied in the Rubber Industry Bill and has been four times before the House of Commons. When it was last debated, about two years ago, the opposition was based mainly on the objection of certain firms to compulsory support of an organisation which they considered to be of no value to them. In spite of this objection, the Bill obtained a second reading majority of 148 votes to 10 and passed through Standing Committee, but did not receive a third reading owing to lack of private members' time before the end of the session.

During the past year, a significant change in the situation has occurred. Many British industries, including the rubber industry, are now protected in the home market by a general tariff. Consequently, the technical efficiency of an industry cannot now be regarded as a purely domestic question for the industry itself. Whatever views might have been held a year ago on what the opposing firms called "the inalienable right of the British trader to carry on his trade without interference", it will be agreed that a protected industry should take a much less individualistic view of its obligations to the community, which voluntarily surrenders its right to carry on its buying without interference. In consideration of the benefits conferred by a tariff, the consumer has the right to expect the industry to give its best in return, and will not be greatly impressed by the plea of a minority which objects to a levy amounting on the average to about 1/1800th part of the selling value of its products for the purpose of improving the scientific and technical efficiency of the industry. In these circumstances, there is little doubt what the verdict of the House of Commons would be if the Bill were to obtain another debate and division.

Unfortunately, this seems unlikely to occur; for the prospects of the passage of a private member's Bill against even the slightest opposition are so small that arrangements have already been made for disbanding the staff of the Research Association when its financial resources are exhausted at the end of this month. If the organisation is to be kept together, action must be taken quickly and the only course now left open seems to be for the Government to declare itself in favour of the principle of the Bill and give it facilities for passing through its further stages. Indeed, considering the dependence of all the industrial research associations on State assistance, it is surprising that the Government, once it adopted tariffs, failed to earmark a part of the revenue thus obtained for the more earnest prosecution of research in every branch of industry.

The Cost of a New World Order

After Democracy: Addresses and Papers on the Present World Situation. By H. G. Wells. Pp. vii + 247. (London: Watts and Co., 1932.) *7s. 6d.* net.

IN this volume of essays, all the product of the last three years, we have the revelation of the thoughts on our present discontents of a student of science turned publicist and perhaps the most qualified of living writers to express either the implications of the scientific outlook in the life of society or the responsibilities which fall on the shoulders of scientific workers.

There is little sequence or relation between the essays other than that conferred by the author's outlook. They range from parliamentary government, economics, planning and world peace to divorce and morals. Each subject is touched upon in the same openmindedness and readiness to accept the consequences of change and development. Mr. Wells reiterates repeatedly the significant facts which our whole system of government and industry are still disposed to burke—the abolition of distance, the growth of human life into a world-wide community of interdependent human beings—and he has no patience with the prejudices or the stupidity which refuse to accept the situation and to meet the consequences, above all with the neglect of the sovereign governments of the world to accommodate themselves to this fusion of once separate economic systems.

This impatience is apt at times to lead to excessive depreciation of factors which may have real value in the scientific order of society which he visualises as essential for the security of mankind. Thus Mr. Wells's denunciation of the evils of nationalism, and his exposure of its persistent menace alike to world peace and to the economic structure of mankind, lead him to repudiate internationalism almost as forcefully. Is this either logical or wise? The international spirit as evidenced in certain forms of world co-operation, such as the health work of the League of Nations, shows itself at least as practicable as the cosmopolitanism to which Mr. Wells leans so strongly and is at least as likely to promote the development of the sense of world citizenship. A sense of civic and municipal responsibility or pride can be a national asset provided it does not displace or overshadow the larger and greater loyalty to the State as a whole. Nor need we assume that if we succeed in stripping our national governments of their militant manifestations, whether in military pageantry, armaments or tariffs, the national units may not learn to co-operate effectively and wisely for the good of mankind as a whole. The League at least offers a framework for constructive work, once the militancy of national governments has been replaced by a spirit of co-operation alike in the direction of a world police force or a world economic policy.

So, too, Mr. Wells's well-founded distrust of nationalism leads him to deny or ignore all its spiritual aspects and the rich contribution to civilisation made within the national framework. To the thinker, no doubt the vision of a world State and the allegiance of world citizenship may make a direct and a nobler appeal. But to lesser minds, the lesser loyalties may be more concrete, and rightly orientated may make the more effective appeal. We may yet see the day when the ordinary citizen is proud of his country according to her reputation for honourable dealing and co-operation in the world comity of nations in the same way that he is careful of his own reputation as a just and law-abiding citizen.

If Mr. Wells has dealt with internationalism with rather unmerited severity, his strictures on the rising tide of nationalism and the many agencies that minister to it are well deserved and should indeed be supported and echoed fearlessly by all who wish to see a scientific order of society. The most significant note in the book is indeed to be found in the emphasis placed on education. It is only as man comes to an accurate knowledge of his environment and relates his knowledge to that action that Mr. Wells sees any hope for the world.

Nowhere in the book is this more clearly stated than in the addresses on "Liberalism and the Revolutionary Spirit" and on "The Commonsense of World Peace". In a footnote to the former address Mr. Wells outlines again the ideas recently formulated under the title "The Open Conspiracy". The basis of his "*Z* Society" is declared to be "the discussion, study, research and propaganda of the sciences of social biology" and "the effective application of their principles to the reorganisation and enlargement of human life". This is nothing else than a challenge to honest, lucid thought about the facts of the situation, and that is basic for the liberation of the world from sectionalism whether national or lesser units are involved. So, too, the basis for world peace lies in the elimination of nationalist teaching and teachers everywhere—the development of a history teaching which leads us on to the great possibilities of the collective human future. "We need an education that will turn mankind from tradition to hope".

Here indeed Mr. Wells is on firm ground, and if his appeal succeeds in stimulating the wide circle of readers, into whose hands his reputation should carry the book, into thinking out some of these implications for themselves, and into refusing to tolerate the wrong kind of teaching or the perpetuation of obsolete jealousies, and sectionalisms, the first steps towards the new order will have been taken. There is no need to dwell on Mr. Wells's obvious failure to show how the minority dictatorship he conceives in his "Z Society" is to succeed while conceding full freedom of thought and expression. Once the vigour of mind, the willingness to accept new situations, to discard old prejudices, which characterise the distinguished author of this book have gained a firm hold on the minds of men generally, we should be in a fair way to realise his vision. But time presses and the danger that before any such widespread movement of thought can occur our civilisation may have tottered to its ruin, is even more acute than Mr. Wells suggests in his somewhat pessimistic sketch "Our World in Fifty Years Time". It is in fact difficult to see how the vested interests blocking the way to world security can be overcome except as governments are captured through the rapid orientation of some major political party to the outlook for which he pleads. To that orientation scientific workers everywhere might even yet contribute the decisive factor.

R. BRIGHTMAN.

An Imperial City of China

Jehol: City of Emperors. By Sven Hedin. Translated from the Swedish by E. G. Nash. Pp. xiv + 278 + 63 plates. (London: Kegan Paul and Co., Ltd., 1932.) 18*s.* net.

THIS book has its origin in the desire of the author's fellow-countryman, Mr. Vincent Benedix, of Chicago, to erect a Lamaist temple, either an original or a replica, in Stockholm and another in Chicago. Sir Sven Hedin, to whom the commission was entrusted, elected to make a replica of the Golden Temple in Potala of Jehol, the city which was once the summer residence of the Manchu emperors. The plans and drawings were made and the material collected—even down to the paint—in the summer of 1930 with the assistance of Chinese architects and draughtsmen. At the time this book was being written, the replica for Chicago, with the accessories of the ritual, had reached its destination and was awaiting erection.

The Potala of Jehol was constructed after the model of the Potala, the famous temple-monastery of Tashilhunpo in Tibet, and was completed in the year 1771. Its erection marked two important events, the gathering of the vassal princes and chiefs, who had recently sworn allegiance, to congratulate the Emperor Ch'ien Lung on his sixtieth, and his mother on her eightieth birthday, and the return to China of the Turgot, or Kalmuks, from Russia after an expatriation which had lasted for one hundred and seventy years. This was also the occasion of a visit to the Emperor of the Tashi Lama, the greatest figure in Northern Buddhism of that era. His death while at Jehol was a misfortune for Buddhism.

Sir Sven Hedin has availed himself of the opportunity afforded by his stay in Jehol to produce an illuminating account of that city as a setting for the Manchu spirit of imperial rule. It is situated some 114 miles from Peking, just outside the Great Wall, and has been described as the Fontainebleau of China. The author has made no attempt to describe its many temples, pavilions and ceremonial buildings in detail, but confines himself to a brief account of the Potala, the Hsin Kung temple-monastery, which was erected to accommodate the Tashi Lama when he visited Ch'ien Lung, the "Temple of the Great Buddha", and one or two more of note.

It is, however, on the historical side of his subject that the author is at his best. He deals with the lives of three great figures of the Manchu dynasty associated with Jehol—the Emperor K'ang Hsi (1662–1722), Ch'ien Lung (1736–1796) and the Manchu concubine Yehonala, better-known to Europeans as the Dowager Empress, who dominated China from 1861 almost up to the day of the Republic. In his account of the two emperors who made China one of the great empires in the history of the world, the author has supplemented European sources, which for the most part are readily accessible, by Chinese records, some not previously translated. Here he has had the assistance of Chinese scholars. These documents are a revelation in so far as they indicate the principles of Chinese imperial policy and even more the Chinese point of view in dealing with the western world. Ch'ien Lung's letter to King George III, in reply to Lord Macartney's embassy of 1792, when viewed in the light of these records, may even serve to assist in the interpretation of recent history in the Far East and Chinese international relations in modern times. There is much to be said on the side of China, as well as in extenuation.

A disturbing account is given of, in some instances, the decay, and in others of the destruction, of irreplaceable gems of art and architecture in this now neglected city. The recently aroused interest of China in her antiquities should not be suffered to neglect even the work of the Manchu dynasty.

In two chapters, one dealing with the march of the funeral procession of the Tashi Lama from Jehol back to Tibet, the other with the flight of the Turgot from Russia, the author's wide and intimate knowledge of central Asia has been drawn upon for two of the most graphic and moving pieces of description in an absorbing book.

Modern Genetical Studies

Recent Advances in Plant Genetics. By Dr. F. W. Sansome and J. Philp. Pp. x+414. (London: J. and A. Churchill, 1932.) 15*s*.

GENETICS, in the broadest sense, is advancing so rapidly, and by so many different methods, that it has already become impossible for either the specialised research worker or the teacher of biology to keep in touch with all the latest discoveries and theories by reading the numerous original publications. Moreover, the literature is so scattered through scores of periodicals that only a very large library can contain even an essential part. For these reasons alone the publication of a book, which, though not of the nature of a general textbook of genetics, summarises the results of research, mainly of the last ten years, must be welcomed by a large number of biologists.

Within the limits deliberately set out in the preface, Dr. Sansome and Mr. Philp have chosen their material most judiciously. It is to be regretted that considerations of space made it impossible to deal more fully with sex in plants, chimæras, and the mathematics of inheritance and populations. A clear exposition for the general worker and 'honours student' of the last subject especially would be of very great value, and the hope may be expressed that a supplementary volume to that now under consideration may be published and include both the biometrics of evolution and genetics and a fuller account of the relationship of genetics to the wider problems of evolution.

Throughout the ten chapters the predominance of cytological methods in modern genetical studies is very evident. An extensive study of chromosome numbers and morphology is leading to a more direct investigation of genic reaction than is possible by breeding alone, but the various kinds of genes (or factors) now recognised have still to be designated almost always from the somatic effects they produce and not from their own nature. In the chapters dealing with the chromosome theory of heredity, and those on polyploids, the reader will find a most valuable summary, illustrated with figures and tables, of the more important of the many recent researches showing the close connexion between chromosomes and the appearance and behaviour of characters in plants. The complexity of structural hybrids and the results of interspecific hybridisation in such genera as *Galeopsis*, *Triticum*, *Nicotiana*, *Crepis*, *Viola*, and *Antirrhinum*, can again only be interpreted satisfactorily when breeding results are correlated with cytological investigation.

The long bibliography (47 pages), of properly quoted references, occupying as it does more than one-tenth of the book, indicates how rapidly the subject has advanced in recent years and suggests that there will soon be a need for another work of a similar kind. The chapter entitled "Conclusions" is, therefore, of a tentative but optimistic nature.

The principles of Mendel have been modified or extended in scope but have stood the test of thousands of experiments with the need for less basic alteration than, perhaps, has been needed by any other original biological theory. Recognition of the interaction of factors with one another and the modifying influences of the environment has led geneticists to a unitary biological point of view. Only hypotheses as to the methods of factor action, how ontogeny is genically controlled, are yet available and probably concern the biochemist and biophysicist more immediately than the geneticist. Combined investigations, however, such as those on flower colour in *Dahlia*, will give facts for testing and improving these provisional suggestions. In another direction the application of combined genetical and ecological methods and results to 'species problems' has already opened up a fascinating field where efficient team-work must include the taxonomist and student of geographical distribution.

It is evident that the work under notice should have a wide appeal at the present time, that it fills, at least temporarily, an important gap in English biological literature, and that it should stimulate a wider and deeper interest in a subject of more than academic importance. W. B. T.

Chemical Examination of Explosives

Chemische Untersuchung der Spreng- und Zündstoffe: unter besonderer Berücksichtigung der zu ihrer Herstellung notwendigen Ausgangsstoffe. Unter Verwendung eines von Hermann Kast hinterlassenen Manuskriptes. Herausgegeben von Ludwig Metz. Pp. x + 583. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1931.) 40 gold marks.

THIS book is practically a demi-official publication as it embodies much of the experience accumulated by the "Centrallstelle für wissenschaftlich-technische Untersuchungen" and the "Militärversuchsamt" up to the time of the Armistice, when they were abolished, and by the "Chemisch-technische Reichsanstalt" which was established afterwards. It is not likely that in any country other than Germany a volume of nearly 600 pages, costing £2 at par, would be published dealing with such a specialised subject. The title does not give a very accurate idea of the scope of the book, for about sixty per cent of it is devoted to smokeless powders and their raw materials and other products which are not strictly either "Sprengstoffe" or "Zündstoffe". The same objection applies, however, to the title of Kast's companion volume "Spreng- und Zündstoffe" published in 1921, which dealt with the manufacture and properties of explosives. Presumably the more comprehensive title "Explosivstoffe" was avoided because it is not a purely German word—an illustration of one of the minor disadvantages of the excessive development of nationalist feeling. The authors, however, have not ignored the work done in countries other than their own.

About half the volume deals with the raw materials used in the manufacture of explosives. Naturally there is nothing very original in these sections, but it will be convenient to the explosives chemist to have the information collected together. It is more in the methods of testing the explosives themselves that the authors' experience will be found of special value.

Some seventy pages are given to stability tests; 40 of these pages dealing with nitrocellulose and 25 with smokeless powders. Like others who have had to deal with this elusive subject, the authors concluded that there is no single test which is really satisfactory, and it is consequently desirable to test a sample by two or more methods. Those favoured, especially for fibrous nitrocellulose, are the well-known Bergmann and Junk test at 132° C. and a storage test at 75° C. In the latter, 5 gm. of the dried explosive is heated in a long stoppered tube for some days until red fumes appear.

In the manufacture of smokeless powders the most important development of recent years has been the introduction of non-volatile gelatinisers which are also efficient stabilisers. They assist in converting the fibrous nitrocellulose into a hard horn-like mass and at the same time act as negative catalysts to the thermal decomposition of nitric esters. Of these substances the most important is "Centralite No. 1", diethyldiphenylurea, which was patented by Claessen so long ago as 1906, but does not appear to have been used on a large scale before the War. Its use enabled the Germans to dispense altogether with the use of volatile solvents in making nitroglycerine powders, and consequently the lengthy drying process was eliminated. With nitrocellulose powders, containing no nitroglycerine, it has not been found practicable to dispense with the volatile solvent, ether-alcohol, because the powder mass is too stiff, even at a temperature of 80° C., to be worked up without danger of explosion. It is, however, added to these powders as a stabiliser, and the surface of the grains is often treated with "Centralite" to make the powder burn in a more progressive manner. Since the War, "Centralite" has been adopted by other countries for the manufacture of their smokeless powders. Kast and Metz give considerable information about the chemistry of this and other similar substances, and a number of methods for its estimation in smokeless powders.

Lead azide, which is now used largely as a substitute for mercury fulminate, is also dealt with adequately. Lead styphnate (trinitroresorcinate), which is added to azide to make it more ignitable, is treated briefly, and some information is given about other comparatively new explosives, such as pentaerythritol tetranitrate.

In consequence of the general plan of the book, the same substance is dealt with in a number of different places, but as there is a good subject index this introduces no serious difficulty. There is no index of authors. ARTHUR MARSHALL.

Short Reviews

(1) *Elementary Textile Design and Fabric Structure.* By John Read. Pp. 95. (London: Edward Arnold and Co., 1931.) *5s.*

(2) *Textile Design and Colour: Elementary Weaves and Figured Fabrics.* By William Watson. Third edition, with Appendices on the Manufacture of Rayon (Artificial Silk) and Standard Yarns, Weaves and Fabrics. Pp. xi+476. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 21*s.* net.

BOTH these books are restricted to the consideration of elementary weaves; but Mr. Read's is also designedly elementary from the instructional point of view, consisting in the main of a series of exercises, whereby the beginner may proceed, step by step, to gain useful knowledge of his subject, and it is well adapted for the purpose. Mr. Watson's book is of a more substantial character, and it displays a grasp of the technique and is accompanied by a wealth of diagram and illustration, that render its value indisputable, even were the latter not suggested by the fact of this being the third edition.

Mr. Watson, like some other present-day writers, seems to hold a different view as to spectrum colours from that held by Sir Isaac Newton and other pre-twentieth century men of science; he writes of six spectrum colours, in place of seven, and regards green (not yellow) as one of the spectrum primaries; in consequence, his views as to the complementaries also differ. Mr. Read's book would have benefited by a freer use of half-tone illustrations of representative fabrics, such as are so liberally introduced by Mr. Watson. The latter's illuminating description of the Jacquard loom and its practical application, and the appendixes dealing with standard fabrics and rayon manufacture sensibly increase the interest of the work.

P. L. M.

Spencer's Scientific Correspondence with Sir J. G. Frazer and Others. Edited by R. R. Marett and T. K. Penniman. Pp. xi+174. (Oxford: Clarendon Press; London: Oxford University Press, 1932.) 10*s.* net.

IN one sense this volume of letters selected from the correspondence of the late Sir Baldwin Spencer is a companion to the journal of the last journey to Tierra del Fuego on which he died. Both in the journal, and in the letters dealing with his work to his friends and co-workers in anthropology, Spencer reveals the inner working of his mind in its reaction to the subject matter of his research and to the ideas suggested in the comments of his correspondents. The letters selected for publication in this volume begin in 1896, the earliest being addressed to Lorimer Fison; the latest is to Dr. R. R. Marett, being dated April 27, 1929, within a short time of his death. By far the greater number, however, are directed to Sir James Frazer, and the editors, happily, have included those sent to Spencer by Sir James in reply. Among other correspondents are Dr. Henry Balfour and Walter E. Roth.

This record of an exceptional personality will be valued by Spencer's friends; but as a collection the letters are of more than sentimental value. As the correspondence, for example, with Sir James Frazer proceeds, it is possible to note the gradual development of Spencer's grasp of the meaning of the material he had gathered, and the testing and modification of the hypotheses which, in their final form, were to become to the anthropologist as household words. Most instructive of all is the interchange of idea and suggestion between Spencer and Frazer in which an ideal co-operation between field-worker and theorist was maintained through many years.

The Social and Economic Aspects of the Drink Problem. Pp. 180. (London: Victor Gollancz, Ltd., 1931.) 5*s.* net.

THIS is the report of a social and economic committee consisting of Prof. A. L. Bowman, Prof. A. M. Carr-Saunders, Sir James Hamilton, Sir John Mann, Mr. B. Seebohm Rowntree, Mr. Cecil Rowntree, Sir Edgar Sanders, and Mr. F. D. Stuart, the honorary secretary. The only injunction was that the report was to be absolutely free from bias, and no attempt was to be made to stress either the good or the bad qualities of alcohol. We may assume therefore that the conclusions arrived at are impartial. They are very interesting. During recent years there has been a large reduction in the consumption of alcoholic liquor. At the present time and under prevailing conditions, drink is not seriously impairing industrial efficiency. Heavy drinking is most noticeable among the labouring and casual classes. The proportion of income spent on drink is about the same on the average as before the War. The poverty-creating effect of drink is little, if any, less. Drink is the cause of about forty per cent of the more common offences dealt with at the public courts. About fifty per cent of cases of assault and wilful damage are due directly to drink. The contribution of the liquor trade to agriculture does not appear to exceed nine millions a year.

The book makes excellent reading, but the difference of opinion of the various witnesses is so great that it is difficult to assess the true value of much of the conclusions to which we are apt to come.

The Journal of the Institute of Metals. Vol. 49. Edited by G. Shaw Scott. Pp. 416. (London: Institute of Metals, 1932.) 31*s.* 6*d.*

THE subject of corrosion, in one form or another, occupies a prominent place in this volume. The Autumn lecture by Dr. Gough gives the most complete account yet available of corrosion-fatigue, an effect which is found more and more to be responsible for the failure of stressed parts in practice, as the conditions are more carefully studied. It is concluded with much probability that stress as such is not an important factor; it is rather strain which is important, especially in its effect on protective films. A further communication by Gough and Sopwith shows that atmospheric air must be regarded as a corrosive agent in fatigue tests on most metals, so that the standard of reference should not be the fatigue limit in air but *in vacuo*. Other communications deal with accelerated and prolonged corrosion tests and with the artificial production of green patina on copper, an example of corrosion deliberately produced and controlled. The electrolytic production of a coating of basic sulphate is found to give the best results.

The technical side of the manufacture of non-ferrous metals is represented by papers on moulds for strip casting and on hot-rolling, whilst laboratory experiments on the removal of gases from molten metals have an important practical bearing.

The abstracts published by the Institute being now confined to a separate volume, the present volume is composed entirely of original communications.

Constitution-Types in Delinquency: Practical Applications and Bio-physiological Foundations of Kretschmer's Types. By Dr. W. A. Willemse. (International Library of Psychology, Philosophy and Scientific Method.) Pp. viii + 266 + 32 plates. (London: Kegan Paul and Co., Ltd., 1932.) 15*s*. net.

DR. WILLEMSE is lecturer in psychology in the University of Pretoria. He discusses the relation of delinquency to types of constitution, basing his ideas on Kretschmer's well-known work; the reviewer prefers the division into leptosome, pyknic, and athletic. One of the most interesting chapters in the book is the author's discussion of other typological studies, particularly with those of Jaensch with his "B" and "T" types which correspond roughly with the cyclothymes and schizothymes of Kretschmer. He points out the similarity between the athletic type of delinquent and the epileptic personality. Athletics are very subject to outbursts of anger and aggressiveness, which outbursts would appear in some way to be associated with the adrenal cortex, and according to Berman, also with the pituitary and male interstitial glands. The notorious Kürten, judging from his photograph, belongs to the athletic type of criminal; he was a typical epileptoid. The subjects of this study were boys between the ages of 16½ and 21½ years, and were confined in the Junior Adult Reformatory at Tokai, and at Houtpoort.

Altogether this book is most readable and introduces us to a very interesting point of view towards crime and the criminal.

Co-operation in Marketing Dairy Products. Part I: *Aims and Agencies;* Part II: *Price Plans.* By R. W. Bartlett. Pp. x + 299. (Springfield, Ill. and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1931.) 21*s*. net.

THE bent of the American mind is towards a greater degree of systematisation than is evident in Great Britain; if an American can reduce anything whatsoever to rule and line, tabulation and percentages, he is entirely in his element. The present work conveys this impression very strongly, but there is no doubt that the author educes strong arguments in favour of co-operative action regarding dairy-products marketing, whether in the form of fluid milk and cream, or the many manufactured processes. The name "Piggly Wiggly Stores" (p. 52) is entirely trans-Atlantic, nor need English people wish to rival such nomenclature.

Before co-operation could reach its present position, many difficulties had to be encountered and overcome; and though there may be room for improvement, the advance in this direction made by the United States is notable. The many charts, tables, graphs and diagrams aid in the elucidation of an already lucid text. The health programme of the National Dairy Council (pp. 104–105) is worthy of the closest attention. Whilst the care exercised in the preparation of the text is manifest, it may be recommended that in a future edition greater attention shall be devoted to exact and orderly arrangement of the index.

Talking Pictures and Acoustics. By C. M. R. Balbi. Pp. ix + 126. (London: The *Electrical Review*, 1931.) 7*s*. 6*d*.

SUCH an up-to-date subject certainly calls for an up-to-date exposition, and this is provided by Mr. Balbi's treatise, which is lucidly introduced by Sir Oliver Lodge.

In a series of nine chapters are sketched out the various points; and so far as a general reader may be expected to grapple with highly technical terms, the subject is brought within such reader's ken. For the scientific workers in filming, the book should be full of suggestiveness. It is satisfactory to note that the fear that deaf people's chief source of entertainment (the moving picture) would be shelved in the near future by reason of the introduction of the 'talkie', is disproved, as "by by-passing some of the electrical energy through a special form of receiver, the audibility afforded can in general be restored to 100 per cent".

One chapter deals with varieties of recording apparatus, and the next considers the various systems of talking apparatus; the accompaniment of clear diagrams and of other illustrations to a well-selected phraseology proves sufficiently attractive. Chaps. v and vi are more directly concerned with the consideration of acoustical properties, and are followed by brief practical notes upon the provision of the ideal studio and the ideal auditorium.

Influence of the Pacific on the Circulation in the South-West Atlantic Ocean

By A. J. CLOWES, Scientific Staff, "Discovery" Committee

FOR some time the ships of the "Discovery" Investigations have been accumulating hydrographic data in the South-West Atlantic in connexion with whaling research, and it is considered that a preliminary account of some of the principal features would be of interest.

The surface water of this area is divided into two main types by two distinct convergence lines. The more southern of these has been named the Ocean Polar Front by Defant[1] and is called by us the Antarctic Convergence, while the more northern is called the sub-Tropical Convergence. Both Defant and Wüst[2] base the position of the Antarctic Convergence on a chart of the surface currents by Meyer, who places it at approximately 50° S. between 45° W. and 5° E., but between 40° W. and 60° W. it is considered that it forms the boundary between the Falkland and the Brazilian currents in about 40° S. Our intensive work in the South-West Atlantic shows, however, that this boundary is part of the sub-Tropical Convergence, and that the Antarctic Convergence is found in 58° 50′ S. south of Cape Horn, and that it continues to the north-east, being found in 49° 50′ S. at 40° W.

The waters of the South-West Atlantic may be summarised as consisting of a surface layer of either antarctic water (in the antarctic zone of the ocean) or of sub-antarctic water (in the sub-antarctic zone), below which is found an intermediate layer of relatively warmer and more saline water above the bottom layer, the Antarctic Bottom water. Wüst agrees with Merz that the intermediate layer of warmer and more saline water is of North Atlantic origin; he also states: "Just as Merz could trace the last vestiges of this water (*N. Atlantic Deep water*) as far as about 65° S. in the observations of Brennecke, so in the east the 'Meteor's' observations place the furthermost limit at 56° S."

The Atlantic Ocean is separated from the Pacific Ocean by the Drake Passage of approximately 450 miles, between South America and the northernmost point of Antarctica at Graham Land. The question arises, What influence has the Pacific on the circulation and composition of the water in the South-West Atlantic? Wüst states that the influence of the Pacific Ocean is of secondary importance. However, our data quickly showed that there is a considerable eastward flow through the Drake Passage on both sides of the Antarctic Convergence. Moreover, this flow is not confined to the surface layer only but is continuous to the very great depths of the Drake Passage. Thus no water of Atlantic origin passes into the Pacific. Lack of space precludes the reproduction of many diagrams, but the topographical chart for the 600 decibar surface in relation to the 3,000 decibar surface is given in Fig. 1. The chart is constructed by making use of the observed densities at 72 stations of which the greater part lie in the Scotia Sea, and gives the stream lines of the currents at the level indicated, assuming the velocity at 3,000 metres is zero, or so small that it does not affect the magnitude of currents at lesser depths. The level of 600 metres has been chosen because in the region of South Georgia the maximum temperature of the intermediate warm and more saline water occurs at 600 metres.

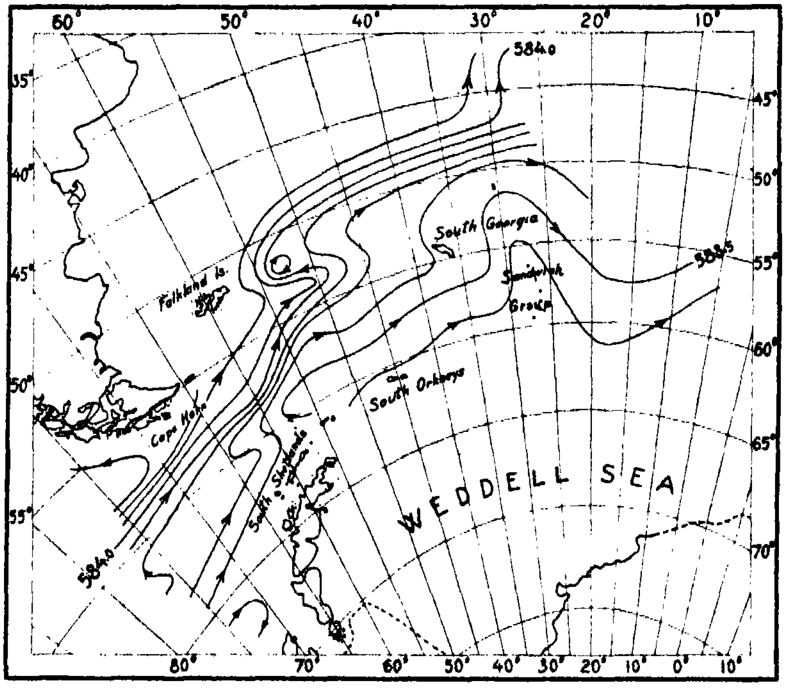

FIG. 1. The currents at 600 metres relative to the currents at 3,000 metres. The lines show the topography of the 600 decibar surface relative to the 3,000 decibar surface.

It can be seen from this chart that the water flows from the Pacific through the Drake Passage in a north-eastwards direction into the Atlantic, and continues northwards of South Georgia. The great bends of the dynamic isobaths in Fig. 1 between South Georgia and the Falkland Islands, between the South Sandwich Islands and South Georgia, and close to Graham Land are characteristic and permanent features and are related to the topography of the sea bottom, but several details may be due to the circumstance that observations from different years and seasons have been combined. At the 2,000 metres level the water flows in the same direction as at 600 metres, but the velocities are much smaller. Thus the maximum velocity at 600 metres is about 32 cm./sec. but at 2,000 metres it is about 8 cm./sec.

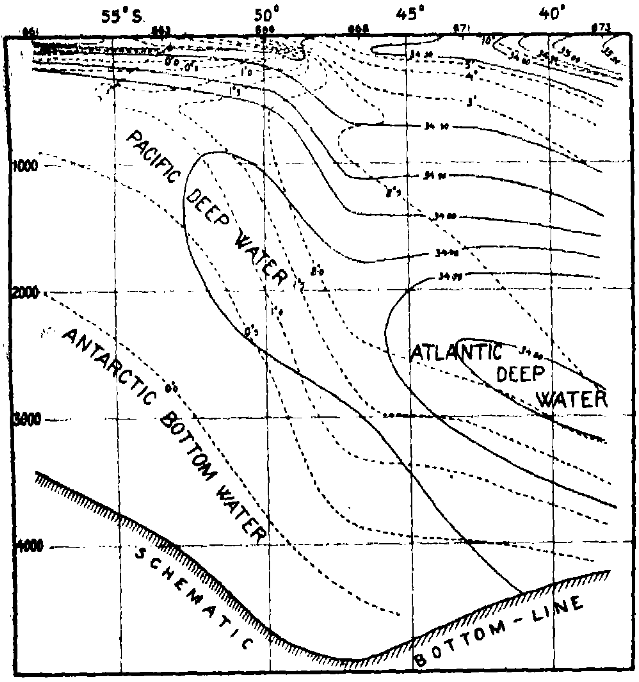

FIG. 2. Vertical section of salinity and temperature along 30° W. from 57½° S. to 48° S.

Fig. 2 is the vertical section of salinity and temperature along long. 30° W. At Station 666, the water of temperature between 1·99° and 1·02° and salinity between 34·62 and 34·73 per mille would have originated in the North Atlantic according to the conception of Wüst, whereas according to our view it came from the Pacific. It has been found by Helland-Hansen that there is a very distinct relationship between temperature and salinity of sea water. Briefly, it may be stated that water masses possessing the same temperature and salinity have a common origin. Thus if we examine the graphs of the relationship between temperature and salinity for a station in the Drake Passage and one or two north of South Georgia, it will be possible to determine the correctness of our view of the water movements in this area. In Fig. 3 the temperature-salinity diagrams for depths below 100 metres have been drawn for three stations, Station 647 in the Drake Passage, and Stations 666 and 671 both north of South Georgia. The agreement between the curves for Stations 647 and 666 is excellent, whereas there is a striking disagreement between the curves for the two former stations and that for 671. Only at depths below 2,000 metres is the water at 666 similar to that at 671 below 3,500 metres, thus showing the common influence of the Antarctic Bottom water from the Weddell Sea at both stations.

Thus the temperature-salinity diagrams agree with the topographical charts that the warm, more saline intermediate layer in the South-West Atlantic originates in the Pacific. It is only north of 46° S. that the deep water shows a southerly component and is of Atlantic origin; south of 46° S. it is of Pacific origin as far as about 55° S., where the influence of the Weddell Sea is predominant.

On the basis of the sections through the Drake Passage, it is possible to compute the total volume of water which flows from the Pacific to the Atlantic, assuming that the velocity is zero at a depth of 3,500 metres. Using data from two different years, 1929 and 1930, one finds nearly the same values, namely a transport of about 110 million cubic metres a second. This transport is more than four times as great as the total flow of water through the Strait of Florida. Considering water of a salinity of more than 34·65 per mille as Pacific deep water, one finds that more than one third of the water which flows through the Drake Passage is of this type, and it is evident that such a tremendous inflow of Pacific deep water to the Atlantic must have an appreciable influence on the character of the water masses in the southern part of the western Atlantic. There it is met with as an intermediate layer between the light surface water and the heavy Antarctic Bottom water.

In conclusion, it is of interest to consider the circulation of the Southern Ocean as a whole. All around the antarctic continent there exists one continuous current, flowing from west to east. Within the upper layer of this current one can discriminate between two typically different water masses, the antarctic water, and the sub-antarctic water of the west wind drift. These two water masses are separated by a boundary surface which

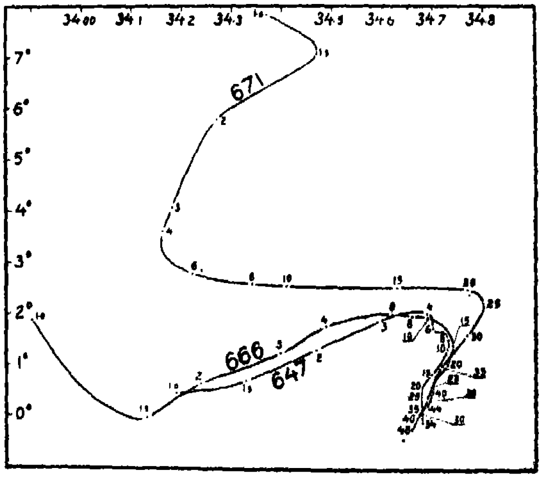

FIG. 3. Diagram of the relation of temperature and salinity for Stations 647 (58° 29¼′ S., 58° 39¼′ W.), 666 (49° 58½′ S., 29° 52¼′ W.), 671 (48° 08′ S., 30° 15½′ W.). The numbers alongside the curves represent the depths of the observations in hectometres.

at sea level is recognized as the line of Antarctic Convergence. To the south of the broad easterly current a series of whirls are probably formed. These circular movements, of which the greatest is found in the Weddell Sea, are stationary and dependent upon the topographic features of the bottom of the sea, and of the coast line of the antarctic continent. In the regions of these whirls the places have to be sought where the Antarctic Bottom water is formed. To the north of the easterly current one finds the sub-Tropical Convergence representing the boundary between the warm and saline water from the Atlantic or Indian Oceans and the sub-antarctic water. Along this boundary surface, whirls are probably also developed, but these are not stationary but represent travelling disturbances which uphold processes of mixing. Through this mixing, the character of the eastward-flowing water slowly changes. The water in 65° S. and approximately 28° W., which Merz and Wüst have considered as being of Atlantic origin, belongs according to our view to the great whirl of the Weddell Sea, which, however, represents a closed system to the south of the current from the Pacific, and therefore the warm and saline intermediate water of the Weddell Sea is for the most part of Pacific and not of Atlantic origin. The so-called Indian Ocean intermediate warm and saline water found in the southern part of the Weddell Sea is no doubt typical water of the circumpolar system.

I have had the advantage of discussing these results with Dr. H. U. Sverdrup, to whom I wish to express my grateful thanks.

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[1] Defant, Z. Gesell. Erdkunde, Berlin, 1928.

[2] Wüst, *ibid.*, p. 506, *et seq.*

Helium Liquefaction Plant at the Clarendon Laboratory, Oxford

By Prof. F. A. LINDEMANN, F.R.S., and T. C. KEELEY

THE main properties of liquid helium have been familiar to men of science for a great many years. The only object therefore in liquefying it is in order to cool other substances the characteristics of which it is desired to study in the neighbourhood of the absolute zero. It has long been known that the heat capacity of solids becomes extremely small at low temperatures. Thus the latent heat of evaporation of 20 mgm. of liquid helium is sufficient to cool 60 gm. of copper from the temperature to be attained with liquid hydrogen boiling under a reduced pressure to the boiling point of helium.

It is easy to design apparatus so that the substances the properties of which at low temperatures are under investigation, are cooled to the temperature of the surrounding liquid or solid helium and maintained at this temperature with a minimum of waste. It seemed preferable, therefore, to instal a small inexpensive apparatus requiring comparatively little liquid hydrogen, which can therefore be operated frequently or duplicated at comparatively small cost, rather than to indulge in a plant designed to produce liquid helium in large quantities. In any event, the financial resources available would have imposed this choice, even had the alternative procedure been considered desirable.

The apparatus which has been installed at Oxford is of a type developed by Prof. Simon and Dr. Mendelssohn in Berlin and Breslau. Two concentric cylinders capable of withstanding a pressure of some 150 atmospheres surround the space in which the substance under investigation is placed. Helium under a pressure of about 100 atmospheres is introduced into the space between the cylinders. The upper part of the annular space between the cylinders is separated from the lower, in which the helium is compressed, by a metal sheet, thus forming a small metal container which is joined by a spiral of thin copper tubing to a source of pure hydrogen. The whole is held in position on a German silver tube in the centre of a larger metal vessel containing hydrogen or helium gas at low pressure which can be evacuated by means of a mercury vapour pump. This outer vessel together with the copper spirals through which the hydrogen and helium are introduced is immersed in a Dewar flask containing liquid hydrogen.

When temperature equilibrium has been attained, hydrogen is introduced into the top vessel under a pressure of two or three atmospheres. Passing through the copper spirals, this liquefies owing to the excess pressure and runs down into the metal container over the double-walled helium cylinder. A tap to the mercury vapour pump is now turned on and a high vacuum produced in the metal box, so that the helium container with its superposed pot of liquid hydrogen is thermally insulated save for the necessary connecting tubes.

The yield of liquid helium is improved if the compressed helium is further cooled by boiling the hydrogen in the inner container under reduced pressure. If the helium is now allowed to expand, about half of it liquefies and the central space with the experimental substances it contains is cooled to the temperature of the surrounding helium. By evacuating the space above the liquid, that is, causing it to boil under reduced pressure, one can, of course, reduce the temperature to within one or two degrees of the absolute zero.

In the apparatus used at Oxford the helium lasts for about an hour and a half. If the experiment is not finished in this time, one can repeat the process in a few minutes at very small cost in liquid hydrogen. The helium expands into a rubber bag and is recompressed into a cylinder so that very little gas is lost. The temperature during the experiment can be observed on a large-scale manometer connected through a fine tube to a small vessel containing helium in the liquefaction space. The apparatus cost approximately £30. Since there is no need to recompress the helium rapidly, a small cheap compressor is sufficient.

The liquid hydrogen required is produced in a plant of the standard pattern designed in the Physico-Chemical Institute in Berlin which has been in use at Oxford for some years now without giving any trouble. Impurities in the hydrogen are condensed by a preliminary expansion and continuously removed by a slow stream of hydrogen. With a compressor capable of dealing with ten cubic metres of free gas an hour and an expenditure of approximately 1·4 litres of liquid nitrogen per litre of liquid hydrogen, this plant produces some 2½ litres of liquid hydrogen per hour. Liquefier and compressor together cost approximately £350.

The liquid hydrogen is stored in pyrex Dewar flasks silvered and exhausted in the laboratory. As their efficiency equalled that claimed for the more complicated double vessels developed by Prof. Kapitza, they have been retained.

If low temperature work expands and a large number of experiments are in hand simultaneously, it may be necessary to consider the use of the continuous Linde process of liquefaction. In view of the cost of the gas and the precautions necessary for its recovery, its distribution involves considerable inconvenience, which for the time being are scarcely worth facing. The mere liquefaction, of course, offers no difficulties and there is little doubt that the Berlin type of apparatus, which is already in use in many laboratories, will prove as serviceable and efficient as the hydrogen liquefier, should it ever be necessary to change over to this system.

Finally, a word of thanks is due to Dr. Mendelssohn, who kindly brought the liquefier over from Breslau and placed all his knowledge and experience unreservedly at the disposal of the department. But for this, it would scarcely have been possible to obtain, without hitch or trouble, liquid helium within one week of the arrival of the apparatus in Oxford.

Metrology by Light Waves at the National Physical Laboratory*

IN 1923 the International Committee of Weights and Measures accepted the eventual use of a wave-length of light as the ultimate standard of length. Already in the previous year the Board of Trade had recognised the need of replacing the existing Imperial standard yard by a standard more in accord with modern requirements. For these reasons it was decided that the National Physical Laboratory should establish means of realising a wave-length standard of length and with it determine the length of the Imperial standard yard in terms of that wave-length.

The paper cited below, by Messrs. J. E. Sears, Jr., and H. Barrell, gives an account of the apparatus and methods which complete the first stage of this programme.

The new apparatus is of the type used by Benoît, Fabry and Perot, but is distinguished from the two previously existing instruments of this type in very many features of design. The more important new characteristics of the apparatus result from two radical departures from what was aimed at in the earlier instruments.

In the first place, Benoît, Fabry and Perot compared their optically determined metre etalon with a line standard by the usual methods of microscope observations, with the aid of fine lines scribed on the polished edges of the terminal glass plates of the metre etalon; the prototype metre being a line standard, such procedure was unavoidable at some stage of the work. In contradistinction to this, the apparatus at the National Physical Laboratory derives the length of an end standard directly from the length of the metre etalon by optical interference, the ends of the etalon being polished parallel to a high optical precision by the Pitter Gauge and Precision Tool Co. of Woolwich by a technique worked out at the Laboratory in 1920. This procedure avoids one of the most difficult steps in the earlier work—the correlation of the positions of the reflecting surfaces of the metre etalon with those of the graduation lines.

Secondly, the new apparatus is so designed that measurements may be made either in air under controlled conditions, or in vacuum, and it thus makes possible new determinations of the refractive index of the air under various atmospheric conditions, which in any event will be needed before a wave-length definition of unit of length can be finally adopted for measurements of the highest precision. Measurements of this kind involve the observation of such variable factors as temperature, barometric pressure, humidity and possibly even carbon dioxide content of the air, and there are disagreements among the published values of the effects of these factors on the refractive index of the air.

It may be also noted here that the separation of the plates in the etalon which is used for the initial measurement has been increased from the 1/16 m. used in the two earlier instruments to 1/12 m., thereby leading to a greater relative accuracy in the basic measurement.

Although the above-mentioned new features of design are in principle the most important, those interested in the design of instruments will perhaps derive most pleasure in considering other details. The apparatus is characterised by a full envisagement of what functions were to be carried out and an adequate provision of means for their convenient and certain execution: one gets the impression that in using the apparatus there will be no need for successive trials in order that an essential adjustment or observation may be secured. Two examples of this must suffice.

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* "A New Apparatus for Determining the Relationship Between Wave-Lengths of Light and the Fundamental Standards of Length", by J. E. Sears and H. Barrell, *Phil. Trans. Roy. Soc.*, A, vol. 231, pp. 75–145. Sept. 16, 1932.

One of the difficulties in the construction of etalons for such an apparatus is in securing that the lengths are exact multiples of the shortest one. Instead of relying on trial and error polishing of the ends, the etalons at the National Physical Laboratory are adjusted by four strain wires symmetrically disposed around the etalon, by means of which changes in length of any etalon of so much as 1 part of 25,000 can with certainty be produced without exceeding the elastic limit of the strain wires.

Again, not only must the supporting mechanism of the longest etalon be capable of the very accurate parallel displacements which are necessary, but such displacements must also be made with certainty and convenience and without varying the distribution of load on the supporting pillar and so forth. The means whereby this manipulation is secured are worthy of special attention.

It is a matter for great satisfaction that the Board of Trade together with the National Physical Laboratory decided to place metrology in the British Empire on a wave-length basis; and the designers and the workshop personnel of the National Physical Laboratory are to be congratulated on the successful completion of the first part of the programme.

Obituary

LIEUT.-COL. J. STEPHENSON, C.I.E., F.R.S.

We regret to announce the death, which occurred in London on February 2, of Lieut.-Col. John Stephenson. He was born in 1871 at Padiham, Lancashire, and was educated at the Burnley Grammar School and the University of Manchester, where he had a distinguished career as a student in science and in medicine. After graduating, he acted as house-surgeon in the Manchester Royal Infirmary and in the London Hospital for Diseases of the Chest. In 1895 he was appointed to the Indian Medical Service and for the next five years was on military duty, including service in the North West Frontier Expedition of 1897. During the following years he was on plague duty and held various appointments as civil surgeon in the Punjab until in 1906 he became professor of biology in Government College, Lahore, of which he was appointed principal in 1912.

In Manchester, Stephenson had studied zoology for two years under the stimulating influence of Prof. Milnes Marshall, and with this foundation he instituted in Lahore instruction in the subject which reached a high standard and within a few years resulted in a productive school of zoology. Several of the students from his laboratories, whom he inspired with his own ideals of critical work and with the need for the investigation of the fauna of their country, are now holding influential zoological posts in India and have published important papers on their researches. His tenure of office in Lahore was marked by conspicuous success as a teacher and by high administrative qualities, and his quiet, effective personality left a deep and lasting impression on his students.

Stephenson resigned his post in Lahore in 1920 and I was fortunate in being able to attract him to the University of Edinburgh, in which he was appointed lecturer in zoology, to share in conducting the courses on invertebrates for senior students. His teaching was clear and concise, with a wide scientific outlook, and he was unsparing in giving help and encouragement, especially to those who were reading for honours in zoology. In Lahore, immediately after taking up his duties, Stephenson began investigations on the aquatic oligochætes of the Punjab and during the next ten years published a series of papers on these worms. His interests then widened to the oligochætes in general and he examined numerous collections from various parts of India. These studies were continued with great assiduity in Edinburgh and in 1923 he published the important volume on the oligochætes in "The Fauna of British India" and became recognised as one of the two chief authorities on the order. Before he resigned his lectureship in Edinburgh in 1929, he completed the masterly monograph on the Oligochæta which was published early in 1930 by the Clarendon Press. Stephenson's mastery of the structure and classification of oligochætes, his extensive knowledge of the literature and his flair for conciseness and clearness in presenting facts and conclusions, enabled him to produce a monograph of exceptional merit which contains also conclusions of general interest; for example, on the bearing of the known facts of geographical distribution on the former existence of a more extensive antarctic continent and of Indo-Australian and other land-bridges, on convergence and on polyphyly. Stephenson was appointed in 1928 editor of "The Fauna of British India" in succession to the late Sir Arthur Shipley.

On leaving Edinburgh in November, 1929, Stephenson went to reside in London and continued his investigations on oligochætes as an unofficial worker in the Natural History Museum until about two months ago. Two years ago he became zoological secretary of the Linnean Society and took an active part in its affairs.

Stephenson was the author during the last twenty-seven years of numerous papers on Oligochæta. His contributions to the advancement of knowledge were recognised by the award in 1920 of the Keith Medal of the Royal Society of

Edinburgh and by his election in 1930 as a fellow of the Royal Society of London.

Stephenson regarded as a recreation his studies, which were carried out with his usual thoroughness and care, in Persian and Arabic history and literature. He published the text, with translation, and with commentary or annotations, of two works, the second of which (Royal Asiatic Society, 1928), the zoological section of the Nuzhatu-*l*-Qulūb ("Heart's Delight") was compiled by a Persian author about the year 1340 and gave a conspectus of zoological science of the time.

Col. Stephenson was held in high esteem as a sincere and loyal friend, for his sound judgment and for his readiness to help in all matters relating to the advancement of zoology in Great Britain and in India. His many friends will feel a deep sense of personal bereavement and will extend their sincere sympathy to Mrs. Stephenson.

J. H. ASHWORTH.

DR. JOHN THOMAS

JOHN THOMAS was born at Harlech in 1886 and died at his home at Wilmslow, Cheshire, on January 18, 1933. He obtained a scholarship at Barmouth County School as a boy and afterwards became a science student at University College, Aberystwyth; he entered at Trinity College, Cambridge, in 1908 with an 1851 Exhibition and, after taking his degree in 1910, was awarded a post-graduate research exhibition by the College.

Thomas soon showed notable talents as an organic chemist and published several papers on this subject while at Aberystwyth and Cambridge. In 1911 he joined the aeronautical section of the National Physical Laboratory as a research chemist and in the following year took up a similar position on the staff of the Nobel Explosives Co. at Ardeer. While at Ardeer he distinguished himself by investigations on novel and delicate explosive compounds which came into prominence during the War; his original experimental work on these and other subjects gained for him the degree of D.Sc. of the University of Wales.

In 1918, Thomas became chief chemist to the Solvay Dyes Co. which had just been founded by Mr. James Morton at Carlisle for the manufacture of fast dyes of the indanthrone group; these important essentials of the textile industry had not previously been made on a technical scale in Great Britain. When the original company was reconstituted as Scottish Dyes, Ltd., Thomas was appointed a director and soon after, in 1923, became the managing director. The manufacture of the fast vat dyes involved the translation of a delicate laboratory technique into large scale practise and for this work Thomas, as a skilful experimenter gifted with marked originality and breadth of view, was eminently suited. During the succeeding years, Thomas's name was attached to numerous patents for the preparation of new and improved vat colours and, as a result, the great works which Dr. Morton established at Grangemouth on the Firth of Forth, now competes on equal terms with the German and Swiss producers of vat dyes. Scottish Dyes, Ltd., was absorbed by the British Dyestuffs Corporation and Imperial Chemical Industries, Ltd., in 1926; in due course, Thomas became joint managing director of the Dyestuffs Group of the latter organisation and held this position until the end.

Thomas was a master of his subject and combined with his experimental genius a fertility in expedient and an aptitude for organisation which are altogether rare; he was a happy and charming personality and a delightful companion. By his untimely death at the age of forty-six years the chemical industry has lost an outstanding figure and many of us have lost a very dear friend.

W. J. P.

MR. C. M. STUART

CHARLES MADDOCK STUART was a member of a large family with a remarkable record of strenuous endeavour combined with religious fervour and a roving disposition; one of his brothers was Canon of Canterbury, the recently deceased Dean of Carlisle was another; the late James Stuart, so well known at Cambridge, founder of the Mechanical School now the School of Engineering, was their cousin. I have briefly set out the family history, in an article in the February number of the *Journal of Education*, as an outstanding example of family heredity.

Stuart was born on September 25, 1857; he died on November 22, 1932. He was educated at Harrow and then entered St. John's College, Cambridge, of which later on he was a fellow. He paid attention chiefly to chemistry and took a first in the Natural Science Tripos in 1880. He next studied with Fittig at Strasbourg. Returning to England, he was first a master at Clifton College, afterwards at Newcastle-under-Lyne under Kitchener; finally, in 1888, he became headmaster of St. Dunstan's College, Catford, S.E., then opened as a new school. He thus came into my neighbourhood and we were close friends from the beginning up to his death. My four sons were educated at the school. Prof. Andrade was one of his pupils; Oscar Faber, the engineer-architect of the new buildings of the Bank of England, was another; Mees and Sheppard, of photographic note, in connexion with the Kodak Co., were also trained at the school. The numbers rapidly rose to five hundred and the school soon became far the best in the Metropolitan area, probably in the country.

He was a keen mountaineer and a man of great physical vigour, as much at home with his boys at cricket and lacrosse as in the class rooms. He was an experimentalist from the beginning, greatly influenced by the exact training he had from Fittig. He is the only head-master I have known who acted as master of method throughout his school: every subject gained through his inspiration. His desire was to make his school suit modern needs. Had the material at his disposal been of a higher mentality, he might have achieved startling results. In a brief note in the *Times* (Nov. 28, 1932) I have ranked him above Sanderson of Oundle, who was trained as a theologian and as an engineer and first became known at the nearby school, Dulwich College, where he established an engineering department, the first of its kind. Comparing the manual work in the two schools, St. Dunstan's was undoubtedly the better, without show and really disciplinary. Sanderson soon became a visionary and cultivated the spectacular: Stuart was to remain a reticent, unassuming Scot; he was almost a Cromwellian puritan in general outlook, without a trace of the cleric and yet a man of great moral force. He put his day school upon as high a moral and social level as that of any public boarding school: this was his great work. He believed in the sympathetic constructive inspector but hated examinations in every shape and form; he did not even accept them as necessary evils; he saw that they made all progress in methods of teaching impossible.

Schools of the type Stuart created are, I believe, the schools of the future. Men of his type will be the future head-masters, if they can be found and provided with proper assistance. Unfortunately we have not yet discovered how to maintain a school when once established—comes a new head and it at once changes. We will not learn from one another; only those who cannot lead will follow a leader. H. E. A.

WE regret to announce the following deaths:

Prof. Eugen Bamberger, emeritus professor of general chemistry in the Technische Hochschule at Zurich, who carried out numerous investigations, chiefly on aromatic and heterocyclic compounds, aged seventy-five years.

Dr. Alfred Eichholz, C.B.E., chief medical inspector, Board of Education, on February 6, aged sixty-three years.

Sir Frederic G. Hallett, O.B.E., formerly secretary of the Conjoint Examining Board of the Royal Colleges of Physicians and Surgeons, on February 5, aged seventy-two years.

Dr. H. Theodor Holm, known for his work on arctic botany and on plant anatomy, on December 26, aged seventy-eight years.

Prof. E. H. Moore, emeritus professor of mathematics of the University of Chicago, president in 1921 of Section A of the American Association, who was known for his work on the theory of numbers, on December 30, aged seventy years.

Prof. A. H. Sayce, formerly professor of Assyriology in the University of Oxford, on February 4, aged eighty-seven years.

Prof. Alfred Schaarschmidt, president of the Institute of Chemical Technology at the Technische Hochschule, Charlottenburg, who was specially interested in problems of nitration, aged forty-nine years.

Sir William Taylor, K.B.E., regius professor of surgery at Trinity College, Dublin, president of the Royal Academy of Medicine, Ireland, since 1927 and president of the Royal College of Surgeons, Ireland, in 1916, on January 29, aged sixty-one years.

News and Views

Award of the Duddell Medal of the Physical Society

THE council of the Physical Society has awarded the tenth Duddell medal to Prof. Wolfgang Gaede, director of the Physical Institute at Karlsruhe, and until recently professor of physics at the Technische Hochschule there. Prof. Gaede's name will always be associated with the design and production of high vacuum pumps. Before 1905 the production of a vacuum beyond that attainable with a filter pump or piston pump was a tedious operation, carried out almost always with a mercury pump of the Toepler or Sprengel type. The remarkable thing about Gaede's investigations is not merely that at the age of twenty-seven he designed a rotary mercury pump which was simple, easy to work, and marked a great advance, but also that since then he has produced at intervals a number of vacuum pumps, each with a definite field of utility, and some of which are based on wholly new principles developed largely by Gaede himself. Thus the rotary mercury pump of 1905 (for many years the pump chiefly used in electric lamp manufacture) and the rotary oil pump of 1907 were followed in 1913 by the rotary box pump used as a backing pump for high vacuum pumps, and by the molecular air pump, which was the first of the really high-speed pumps. In 1915 came the mercury vapour diffusion pump, the forerunner of nearly all the high-speed vacuum pumps used to-day, whether employing oil or mercury vapour. Within the last ten years, Gaede has designed a family of pumps of several stages, incorporating both the high-vacuum and the fore-vacuum pump into a single unit. A recent outstanding development was the large single-stage diffusion pump designed by Gaede for work at Leyden on solid helium. This had the remarkable speed of several hundred litres per second at a pressure of 1/1000 mm. mercury.

White and Black in Africa

SOME essential factors in the problems affecting the future of the white and black races in Africa were indicated by Mr. Frank H. Melland, formerly of the administrative service of Northern Rhodesia, in a lecture on "Witchcraft in Africa" before the African Society on January 31, at which Lord Buxton was in the chair. Mr. Melland pointed out that while the native visits the white man on a friendly basis and brings certain of his troubles to him, this does not apply to witchcraft, because the white man does not believe in it. The problem is to teach the black man to think 'white', just as we ourselves in many parts of Africa are trying to think 'black'. Hence Mr. Melland stressed the value as an educative influence of carefully selected films of British life which should be brought before the native. While it is perfectly obvious that as the conditions of life and hygiene in tropical Africa become better understood, the number of white settlers will increase, it is frequently overlooked that the black man is equally a permanent element in the future situation which must be taken into account. As Mr. Melland pointed out, he will not disappear as the red man in America or the Australian blackfellow have disappeared, nor will he survive as an historical curiosity. The Bantu are the most virile and persistent racial stock extant, and they outnumber the white man in the highlands of Africa by fourteen to one. Lord Buxton, judging from his own experience, thinks that the belief in witchcraft is by no means so strong as it was some years ago; but taking this as symptomatic of advance in other directions, progress must be slow. If it were not for difficulties of which there has been abundant evidence recently, it would seem scarcely necessary to urge the necessity for the scientific study of native ways of thought and institutions to ensure that progress in native development is in a direction which will permit of the two races living side by side in one community, as forecast by Mr. Melland.

Aims of Anthropological Research

PROF. FRANZ BOAS of Columbia University, in his presidential address to the American Association for the Advancement of Science at the meeting at Atlantic City in December last, made a survey of present-day methods of approach in anthropological research, which was remarkable not only for the thoroughness with which it traversed the ground, but also for the critical acumen which probed weak spots in the theories dominant at the moment in the various schools of thought. He suggested caution in estimating the possibilities of formulating general laws. His final conclusion is that the study of 'foreign cultures' should enable us to see how many of our lines of behaviour, that we believe to be founded deep in human nature, are actually expressions of our culture and subject to modification with changing culture. "By a study of the universality and variety of cultures," he said, "anthropology may help us to shape the future course of mankind." Prof. Boas, holding that the objective of anthropology is the attempt to understand the steps by which man has come to be what he is biologically, psychologically and culturally, also holds that its material must be historical in the widest sense of the term, and that in the argument for diffusion it is not a safe method to assume that all analogous cultural phenomena must be related. "It is necessary," he says, "to demand in every case proof of the historical relation, which should be the more rigid the less evidence there is of actual recent or early contact." Prof. Boas's address appears in full in *Science* for December 30, pp. 605–613.

Dr. John Roebuck, F.R.S., 1718–94

WE learn with interest that the tomb of Dr. J. Roebuck, one of the founders of the famous Carron Iron Works, Falkirk, has recently been restored. Roebuck was born in Sheffield in 1718 and after studying in Edinburgh took the degree of M.D. at Leyden. Returning home, he practised in Birmingham, but, becoming interested in practical chemistry, he was successful in introducing the use of lead chambers into the manufacture of sulphuric acid. In 1759, with Samuel Garbett and William Cadell, he founded the Carron Company, the first concern in Scotland to use coal for smelting iron and the first to use ironstone from the carboniferous formation of central Scotland. Roebuck was the friend of Watt, Boulton, Smeaton and Black, and was a fellow of the Royal Societies of London and Edinburgh. He died in July 1794 at Bo'ness, near Grangemouth, and was buried in Carriden churchyard. His grave is surrounded by a low wall while at the head of it is a marble tablet bearing a long inscription in Greek and Latin, referring to his studies in chemistry and metallurgy, which sciences "he expounded and adapted to human needs with a wonderful fertility of genius and a high degree of painstaking labour". The restoration of the tomb has been carried out by the descendants of Dr. Roebuck and the Carron Company. The Company, it may be added, has published an interesting series of leaflets recalling some of the famous men who have been associated with the works.

Lancaster Frankland Society

AT a meeting held in the Storey Institute, Lancaster, on January 18—the anniversary of the birth of Sir Edward Frankland in 1825—a proposal was brought forward to form a society in Lancaster to perpetuate the memory of this great chemist. Prof. H. E. Armstrong, Frankland's oldest living pupil, in the course of an interesting address, reported in the *Lancaster Observer* of January 20, lent his support to the proposal. Frankland, he said, went to Lancaster at a very early age and remained until 1845, attending first a private school and afterwards the Royal Grammar School; a valuable part of his training was obtained also during his apprenticeship in a local druggist's shop, for there he learnt to use his hands. Prof. Armstrong expressed the hope that the founders of the organisation would remember Frankland not only as a chemist but also as a man of wide attainments, and that besides chemists they would include botanists, geologists, and particularly sanitarians—for Frankland's important work in giving Great Britain a pure water supply lay in association with sanitary science. In supporting the proposal, Dr. Shackleton Bailey mentioned various past pupils of the Royal Grammar School, Lancaster, who have achieved eminence in science, among them being Sir Edward Frankland in chemistry, Sir Richard Owen in biology, Prof. Seward in botany, and Prof. Marr in geology. A letter of support was read from Prof. P. F. Frankland. Prof. Armstrong is to be president of the new society, which, it has been decided, shall be called the Lancaster Frankland Chemical Society.

Biology's Message for Civilisation

IN an address to Sections D and F of the South African Association for the Advancement of Science in July 1932, Prof. H. B. Fantham, recently elected to the chair of zoology in McGill University, Montreal, essayed to interpret biology's message for the plight of modern civilisation (*South African J. Sci.*, vol. 29, p. 533). Prof. Fantham regards the expenditure on education as excessive, and the subjects taught too many; his own ideal list includes general elementary science (including biology), the languages of the country, reading, writing, arithmetic, economic and human geography, history, some cultural subject like singing, needlework and cookery for girls, drawing and woodwork for boys, moral principles, and perhaps simple drill, anything beyond these to be paid for by the parents concerned. Elementary education alone should be free, for so-called free education is 'free' only to the parents directly concerned and not to the community. The mechanisation of the modern world is a disharmony, which is narrowing and starving human life. Doles are "perhaps the greatest biological mistake in the social organisation of the present age"; relief should be made conditional on the giving of service. Generally, Prof. Fantham holds that there is too much administration, too much organisation, too many conferences and too much mechanisation, so that man's environment has become too artificial, and the result of the disharmony is expressed in instability and unrest. Some suggestions made by the author are that government must be by paid business managers trained in science and administration; that production must be adjusted to demand and the scientific organisation of distribution; that wages should be judged by their purchasing power; that the movement back to the land should be encouraged; that wars should cease and war debts be cancelled; and that eugenic measures should be employed to cope with problems of over-population.

The Language Difficulty and Scientific Progress

DURING the course of a year we receive many journals, reports of congresses, and papers printed in languages which, it must be admitted, are unfamiliar to the majority of scientific workers and sometimes in alphabets which add to the difficulties of interpretation. Fortunately, the custom is growing of adding to each paper a summary of its contents in English, French or German, but no summary can ever replace, for a scientific worker, the detail of the method and observations of the paper summarised. The relegating to comparative obscurity, on account of the language difficulty, of many papers of value is all against the progress of scientific knowledge, and it is for that reason that we venture to appeal again for an increased use, if not in whole at least in summary, of the languages which have come to be recognised as the general vehicle of scientific researches. The tendency of recent times was the subject of discussion at the fifteenth annual meeting of the American Society of Ichthyologists and Herpetologists in Washington, D.C., in May 1932, and the following resolution was passed unanimously: "Whereas, a large number of ichthyologists and herpetologists of countries using non-Latin alphabets are publishing their papers in the English language; therefore, be it resolved that the American ichthyologists and herpetologists, through their Society, desire to thank their fellow scientists of other lands for publishing in English."

Use of the English Language

AT the Friday evening discourse at the Royal Institution on February 3, Dr. Cyril Norwood discussed the use of the English language. Dr. Norwood directed attention to the particular dangers to present-day writers arising from the rapid wear and tear of words and phrases, and the decay of metaphors, and pointed out that these arise from, among other things, the excessive use of technical language which reduces words to a system of symbols. Illustrations from the works of leader writers and of men of science were given to show the kinds of error which are very frequent, and to illustrate methods of style which delay the reader's apprehension and defeat the writer's object. The methods of Darwin, who was without natural gifts of style, but took infinite pains to render his writing clear and attractive, were examined and Dr. Norwood suggested that Darwin's example could well be followed. A similar study of Huxley was made, and Dr. Norwood quoted a passage from his writings which he considers is a model of written English.

Economic Value of Agricultural Science

THERE must be few engaged in research who have not been called upon to justify the policy of scientific examination of technical problems in face of the apathy or distrust of the practical man. This is particularly so in the case of agriculture, in which it is still possible to continue by the use of traditional methods. Fortunately, the list of scientific achievements which have given the cultivator vastly greater command over the forces of Nature is a long one; and the critic may be made to realise that practically the whole agricultural technique that was not possessed by his grandfather is the direct outcome of scientific research. In an address delivered to the Wellington Philosophical Society on October 26, Lord Bledisloe, Governor General of New Zealand, very ably sets out the economic value of agricultural science. Addressing his remarks to the primary producer, Lord Bledisloe points out that only by fostering scientific research and applying its results to practice can a place be maintained in world markets, continually more congested and more exacting in their requirements. Research, however, must be thorough, tested out in all its bearings, and put before farmers as a sound investment. Surveying the whole agricultural field, the leading achievements of agricultural research which have led to definite economic results are touched on, and even to those familiar with the subject the cumulative result is impressive. The problem of production has been solved. The famines predicted from time to time in the recent past are not likely to trouble us. The need for the future is to get into wider circulation the plenty which improved methods have secured.

Gold and Silver Currencies

IN a recent publication ("'Standard Gold' and Silver: the Way out of the Crisis." Pp. 88. Manchester: Taylor Garnett Evans and Co., Ltd., 1932), Dr. Ernest Zucker advocates the devaluation of the world's gold currencies by means of a one-third reduction in the gold content of the standard coins. He also advocates the introduction of silver as a subsidiary currency to facilitate trade with the silver-using East. The effect of the first proposal, he argues, would be to raise the prices of raw materials and similar commodities by about half, since their prices are world prices based on gold. The purchasing power of wages and salaries, on the other hand, would be reduced by about a third. In this way the disequilibrium between the prices of raw materials and manufactured products could be removed, while inter-allied debts and reparations would be reduced by a third. Dr. Zucker's scheme, however, presents serious difficulties. First there is the practical problem of securing common action among creditor nations, especially the United States and France. Secondly, devaluation would not in itself re-adjust the maldistribution of gold. Creditor countries would continue to attract the world's gold and if they persisted in high tariff policies, it would still be difficult for debtor countries to make payments, or for the volume of world trade to be increased.

Daily Mail Ideal Home Exhibition

THE *Daily Mail* Ideal Home Exhibition will be open at Olympia, London, W., on March 29–April 29 According to advance information recent developments in illumination will be utilised to create in the Grand Hall of Olympia, a 'Rainbow City'. The colours of a great rainbow, appearing from among 'clouds of depression', will be produced by a gigantic scheme of neon lighting, and the eye will travel back over a hall in rainbow hues to 'the sun of prosperity'. Scientific workers will be attracted by a series of "Rooms of the Scientists" on the first floor of the Empire Hall, where we are promised representations of the surroundings in which Newton, Faraday, Marconi and others carried on their investigations. A section of the Exhibition will be devoted to the home cinema, while close by will be the telephone exhibit of the General Post Office. Modern sanitation, heating and refrigeration apparatus, lighting schemes, general house equipment and labour-saving devices—indeed, everything for home service, comfort and recreation—are other and more usual features of the annual exhibition.

Land Utilisation Maps

THE Land Utilisation Survey has produced through the Ordnance Survey two one-inch sheets embodying some results of its work. These are sheets 114, covering the area to the south-west of London, and 142, showing the Isle of Wight, Portsmouth and the southern part of the New Forest. They are published at 4*s*. each and the sheet lines are the same as those of the popular 'one-inch' maps. Results are reduced from the original 'six-inch' survey and printed in six colours over the topographical detail and contours of the original ordnance sheets—on which the rivers appear in blue. Dark green shows forest and woodland, light green meadowland and permanent pasture, brown arable or tilled land, including grass grown in rotation and land lying fallow at the time of survey, yellow heathland, moorland, common and rough hill pasture and purple garden allotments and orchards. Land that is agriculturally unproductive, including built-over land, quarries, yards and roads is shown in red. Private parks and golf courses have been divided according to the use made of the land for grazing or other purposes. The maps are beautifully produced and give a striking picture of the uses to which land in Great Britain is put and should prove invaluable for many purposes. It is hoped to publish further sheets in course of time.

Dried Poultry Manure

THE possibility of making better use of poultry manure is receiving considerable attention at the present time and in the *Journal of the Ministry of Agriculture* (vol. 39, p. 656) R. Sayce and F. Hanley give an interesting account of the production of kiln-dried poultry manure. The kiln, which is very similar to that used in maltings, is a ventilated brick building with a corrugated asbestos roof which is lined with asbestos sheeting. It is heated with an ordinary coke furnace and a system of flues. After a preliminary drying in the air for about two days, the manure is spread on the kiln floor to a depth of 7–8 in., being turned occasionally during treatment. The time required for the drying process depends on the state of the material, its depth on the floor, weather and other conditions, but 48 hours should be sufficient for average material 6–7 in. deep, the maximum temperature during the process usually approaching 300° F. Four tons of manure may conveniently be treated at a time and will yield approximately two tons of dried material, which should not contain more than 7–10 per cent moisture if it is to store satisfactorily. Some loss of nitrogen during the drying is unavoidable, but analyses show that the final composition of the poultry manure closely resembles that of other organic fertilisers, which sell at £3 10s.–£5 a ton, at present in considerable demand in market gardening districts. In addition, the constituents are present in a readily available form.

Forest Products Research in the United States

THE valuable research work which has been carried out at the Forest Products Laboratory of the United States Forest Service, which is situated at Madison, Wis., is well known. According to Science Service, Washington, D.C., many difficulties are encountered in seasoning wood, and a treatment is being sought which will prevent, or greatly reduce, shrinking and swelling, thus removing one of wood's principal disadvantages. Fire-retardant treatment is under investigation and several combinations of chemicals are said to give promise of practical results. Great improvements in the manufacture, preparation and use of glues have been made in the last decade. Experiments which are being undertaken appear to show that plastic compounds from chipped wood or pulp fibres have possibilities of competing with other products for panels, tiles, mouldings and other articles, a development which the lover of the genuine article will not regard with great pleasure. Some other problems awaiting solution are forecast by Mr. Arthur Koehler, the officer in charge of sylvicultural relations at the Forest Products Laboratory. For example, joints and joint fastenings, now the weakest part of wooden structures, require improvement. It is held that wood could be made more attractive by colouring with transparent dyes or treatment with gases, such as ammonia, increasing lustre by transparent coatings, or treatment of wood itself. On the subject of wood working machinery scientific study is required as, for example, the development of a planer which would leave no marks, thus eliminating sanding and raised grain troubles.

Meteorological Records of Southport

FEW towns possess such accurate and long meteorological records as Southport. This is largely due to the late Mr. Joseph Baxendell, whose work has been carried on and extended by his son, for many years meteorologist to the Southport Corporation. Each year's records are summarised and discussed in an annual report; the report for the year 1931 has recently been published. There is a number of tables in these reports which differ in form from any of those appearing in the annual summaries of the Meteorological Office, and these add greatly to the value of the series. Among them may be mentioned those showing rainfall with different wind directions, diurnal variation of the duration of sunshine (totals for each hour of the day for each month) and mean level of subsoil water. This last table is a particularly interesting one. It has been maintained for forty-nine years, first of all by the late Mr. J. Baxendell at a private house in Liverpool Road, Birkdale, and later at 34 Kent Road, Birkdale, by Mr. James France and his wife. The record unfortunately ends at the close of the year under review, but alongside the last set of monthly figures appears similar information for the recently established meteorological station at Bedford Road Park, which is in the same part of Southport. To those not very familiar with this subject these single year's observations are not without interest, as they show differences of response to the meteorological conditions in spite of the proximity of the two wells used for making the measurements. June 1931 was very wet at Southport—5·99 inches of rain fell at Bedford Road Park—and the mean level of water in the shallower well at the older site rose in June almost to its February value, which was by no means the case at the other deeper well. The last six months of 1931 yielded altogether substantially more than the normal rainfall, but the average level of the shallower well almost returned to its normal value.

Electrification of the Swedish State Railways

THE primary object of electrifying the State railways in Sweden was to make them independent of foreign fuel. In 1920, when the project was first considered, the probable future price of locomotive coal was considered to be about £8 per ton. To make a more accurate estimate, local and English experts were consulted and they considered that the price would not fall below £2 15*s*. per ton. In spite of these estimates, the price of coal has continued to fall. In 1923 it was less than £2 per ton, it then fluctuated for several years about £1 per ton and it was only 16*s*. a ton in 1931. These fluctuations in the price of coal make it difficult to estimate the economy effected by electrification. At present, two sections of the Swedish State Railways are in electrical operation; the Ore railway in the north (280 route miles) and the Stockholm-Göteborg line (285 route miles). The electrification has increased the carrying capacity of the Ore railway by about fifty per cent and the average speed of the trains has been doubled. In a paper on the Swedish railways read to the Institution of Electrical Engineers on January 5, Mr. Öfverholm pointed out that the results on the Ore railway would have been more satisfactory if the existing station arrangements had been altered so as to allow longer trains to be employed. Considerable extensions of the system are being undertaken. By the end of the present year, 1,680 route miles of the State railways will be electrified. This corresponds to about forty per cent of the complete railway system. Several difficulties were experienced when electrification was first adopted. The disturbance on the telephone lines was obviated by suitably arranging the suspending wires of the power lines. By taking the power for the railway operation from the national distribution system, considerable economies were effected. The project of connecting the Swedish and Norwegian railways by a new bridge at Svinesund is being considered.

Andaman and Nicobar Islands

THE publication of the census report on the Andaman and Nicobar Islands (Census of India, 1931: vol. 2. Calcutta: Central Publication Branch; 7*s*. 6*d*.) has given an opportunity for the production of a valuable monograph on the aborigines of these islands, the cultural anthropology of the Nicobar natives and various reports on the forests, agriculture and trade. Most of these reports are by Mr. C. J. Bonington, but several other writers have collaborated in the work. The Andaman population of 19,000 shows an increase, but this increase is solely in the convict and other immigrant population. The aborigines have fallen in number to 460 compared with 786 ten years ago, 1,317 in 1911, and nearly 5,000 when contact with an introduced population began in 1858. There seems to be little hope of these races surviving. On the other hand, in the Nicobars, where there has been little disturbance with the natives or their tribal systems, the aboriginal population shows a steady increase during the last thirty years and is now nearly 10,000. The figures in several of the islands are based on estimates but there is no reason to doubt their accuracy.

Sterility in Domesticated Animals

A USEFUL bulletin has been issued from the Imperial Bureau of Animal Genetics, Edinburgh, (*2s. 6d.*), on the physiological and genetical aspects of sterility in domesticated animals. It is written by Dr. William Orr and Dr. F. Fraser Darling, and a full bibliography, prepared by Miss M. V. Cytovich, is appended. Successive sections deal with physiological aberrations in the reproductive system, the nutritional aspects of sterility, and types of sterility referable to genetical causes. This will be of service not only to all those engaged in practical animal breeding but also to those engaged in research on the physiological or genetical aspects of animal sterility.

Centenary of Sir John Kirk

IN connexion with the centenary on December 19 of Sir John Kirk (see NATURE, **130**, 920, Dec. 17, 1932), a portrait of Kirk was unveiled at the Zanzibar Museum, Zanzibar, by Sir Richard Rankine, British Resident for the Protectorate, in the presence of His Highness the Sultan. A number of exhibits associated with Sir John Kirk were displayed at the ceremony.

Effect of the Preying of Birds on Butterflies

MR. C. L. COLLENETTE writes from the Entomological Department, British Museum (Natural History), South Kensington, London, S.W.7, that he is making an investigation into the extent to which butterflies in the perfect or imaginal state are preyed upon in the British Isles by birds, and he would be glad to have any first-hand observations, giving, where possible, the species of both butterfly and bird, the date and locality, details of mode of capture, etc. Wings detached by the bird are of value, both as evidence of identity, and also by reason of the imprint of the bird's beak which is sometimes shown. Published records up to and including the year 1908 have been summarised in a paper by Sir Guy Marshall entitled, "Birds as a Factor in the Production of Mimetic Resemblances among Butterflies" (*Trans. Ent. Soc. Lond.*, 329–383, 1909). Mr. Collenette is making a search in both entomological and ornithological literature for British records published since this date, and he would be pleased to receive references especially in the lesser-known publications.

Announcements

A DISCUSSION on "The Raman Effect in Relation to Some Chemical Problems", to be opened by Dr. J. J. Fox, will be held at the Chemical Society on February 16, at 8 P.M.

DR. S. COURTAULD, a trustee of the National Gallery and founder of the Courtauld Institute of Art, Mr. E. G. V. Knox, editor of *Punch*, and Dr. N. V. Sidgwick, F.R.S., fellow of Lincoln College, Oxford, and member of the Advisory Council of Scientific and Industrial Research, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts or for public service.

THE next sectional meeting of the World Power Conference will be held at Stockholm on June 28–July 4. Reference was made to the programme in connexion with this meeting in NATURE of January 7, p. 22. Forms of application for membership can be obtained from the British National Committee, World Power Conference, 63, Lincoln's Inn Fields, London, W.C.2.

THE following have been elected officers of the Royal Meteorological Society for 1933:—*President:* Prof. S. Chapman; *Hon. Treasurer:* Mr. R. A. Watson Watt; *Hon. Secretaries:* Dr. J. Glasspoole; Mr. W. M. Witchell, and Dr. A. Crichton Mitchell; *Foreign Secretary:* Capt. C. J. P. Cave; *New Members of Council:* Mr. J. H. Field, Dr. B. A. Keen, Capt. W. N. McClean, and Dr. F. J. W. Whipple.

THE Central Scientific Company of Chicago has issued the first two numbers of a bulletin entitled *Cenco News Chats* which is meant to furnish to the public interested in instruments an up-to-date account of new developments in apparatus for which the Company is responsible. It is less formal than a catalogue, is well illustrated and does not enter into scientific details. We learn from it that the Bunsen burner with an H base with side entrance for gas and bottom for air is the most popular, and that the wire gauze over the flame should be iron 16 mils in diameter and 16 to the inch. Spectra photographed by means of a Wallace concave grating replica with a ruled surface only 28 mm. by 20 mm. are reproduced, and a short account of the Hahn X-ray spectrograph is given. Copies of the *News Chats* may be obtained on request from Messrs. Edwards, Allendale Road, London, S.E.5.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A temporary inspector in the Markets Division of the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 (Feb. 20). A principal and head master of the Maidstone Technical Institute and Junior Technical School—Mr. A. W. Peacock, Education Department, Tonbridge Road, Maidstone (Feb. 25).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Origin of Curls and Twists in Wool Fibres

WILDMAN[1] has recently discussed the sequence of development of the fœtal lamb's coat, showing early anterior to posterior and later secondary progressions in follicle initiation over the skin surface. He directs attention to the spiral shape of wool follicles and the changes in direction of the growing point as development proceeds, concluding therefrom that the shape of the fibre is largely determined by the shape of the basal portion of the follicle.

The prototrichs characteristic of the natal coat, as described by Duerden[2], exhibit all shapes of tip from sickle to fine curly, the form being apparently related to the kind of growth which proceeds. Thus a gradual increase of thickness (presumably with progressive enlargement of the follicle growing zone) leads to the 'sickle tip' condition, while curly tip is associated with a mere elongation of extruded fibre without change of cross-sectional area. Irregular waviness is then exhibited in each prototrich before fibre production 'settles down' to that of the definitive fibre more typical of the adult coat and in general of more regular growth; that is, until the follicle population assumes its normal adult activity, when the definitive fibre structures continue as spirals, waves or with helical twists. The work of S. G. Barker and his collaborators[3,4] on 'crimp' apparently justifies the conclusion that a *straight* fleece fibre is extremely rare. The region of activity of the various forces imposing curl and twist upon the fibre must clearly lie within the lower parts of the follicle, although its characteristic shape may conceivably be modified by other forces, acting on the parts still surrounded by the follicle structure, such as varying rates and zones of dehydration (vide King and Nichols[4]). The direction of emergence of the fibre is generally not perpendicular to the skin surface and directional currents of fibre slope may be observed in many forms, though on the fleece areas they may be more or less obscured by the density of the fibre population, and, in the birth coat, by the tendency for groups of extruded fibres to approximate into the familiar lamb's coat 'spirals'.

The different forms of spirals (for example, horns in sheep) which result from larger accretionary growths have been discussed by Thompson[5] and Huxley[6] on mathematical premises based upon the existence of growth gradients about different axes of the growing region. A suggestion may be made that similar systems may operate within the comparatively restricted growth zones of hair follicles. It is conceivable that the forces within the follicle required to give rise to the various curved forms of fibre may follow upon different growth intensities (yielding different rates of elaboration of fibre substance) at different aspects of the follicle. Any asymmetry of the follicle growing zone could allow of differential rates of production of fibre constituents, while the disposition and orientation of the follicle in relation to the general growth gradients would affect the direction and magnitude of the forces at play.

Thus the form growth of the wool fibre would simulate in miniature that of the sheep's horn (omitting except in early stages the increase of cross-sectional area). The definitive fibre continues as a spiral, a uniplanar wave or with twist, whichever be the characteristic deformation associated with the type of follicle involved.

As a corollary to Thompson's studies of horn shapes and to the views here proposed, an explanation of the rarity of straight fibres in fleece growth seems possible. The essentials for a perfectly straight fibre would thus be symmetry of the basal portions of a follicle about a line perpendicular to the skin and the absence of differential intensity of growth. The follicle would have to be situated at a point of zero gradient, such as at the centre of a true hair whorl. These considerations would seem to render the production of a perfectly straight fibre extremely improbable.

J. E. NICHOLS.

Wool Industries Research Association,
Torridon,
Leeds.

[1] *Proc. Zoo. Soc.*, Pt. 2; 1932.
[2] NATURE, **130**, 736, Nov. 12, 1932.
[3] *vide* "Wool Quality", H.M. Stat. Office, 1931.
[4] *Trans. Faraday Soc.*, **29**, Pt. 1; 1933.
[5] "Growth and Form", 1917.
[6] "Problems of Relative Growth", 1932.

Further Mutations in the Amphipod *Gammarus chevreuxi*, Sexton

NEW developments in *Gammarus chevreuxi* have appeared in the course of some experimental work on the question of the origin of recessive characters, and how far they may be present in the wild.

During the past twenty years we have examined more than half a million of these *Gammarus* as they were brought in from the wild, but with regard to the black retinular pigment of the eye, so far not a single variant has been seen. We have, however, found more particularly in recent years that variations occur in the amount of the white superficial pigment.

In the laboratory[1] on the other hand a number of recessive mendelian characters have arisen, principally relating to the eye, though in one instance[2], the 'white-body' of Stock II, the body colour was also affected. Changes of colour, such as red, white, purple, took place in the pigment of the retinular cells, and in one mutation, the 'albino' of Stock I, the cells themselves were lacking. In several stocks 'nowhites' appeared, that is, animals with none of the superficial white pigment in their eyes.

A new departure among the recessive characters that have recently appeared is a *red-eye* with which is associated *nowhite*, the two characteristics, namely, complete lack of both black retinular pigment and white superficial pigment not having up to now segregated from one another. The original black pair gave a black F_1 brood of 12, which, intermated, produced an F_2 of 49 blacks and 12 of these red-with-nowhites.

This new stock is a very distinct one, as proved by cross-matings with recessives of nine other strains, whitebody, lilac, six other and different reds, and the red-nowhite of Stock I. The last mentioned mating, red-with-nowhite with Stock I red-nowhite gave, for the first time in the nowhite matings of this species, normal blacks, that is, black eyes with the white reticulation.

Another new mutation is the *lilac-eye*. In this the recessive eye when hatched is a pale clear lilac colour, with white reticulation, but as the animal grows the white reticulation practically vanishes, and the colour fades from the centres of the ommatidia to collect in thin dark rings around the cone-margins, giving the effect of an eye composed of creamy white circles set in black or brown network. This, too, is a simple mendelian recessive. A curious occurrence must be noted in the blacks of the F_3 and F_4 generations of this lilac stock. Five of the females, normal in body colour and in the dark green gonad colour, gave white eggs; seventeen batches of eggs were laid, but no young hatched.

The other interesting new features of the experiment are the reappearance of the white-body mutation in the F_3 of another stock, and the reappearance of the Stock II red-eye (1922) in no less than five of the new stocks, three in the F_2 generation from the wild, and two in the F_3 and F_4.

Mated *inter se*, and with Stock II recessives, the results were as in Stock II, namely, red mated with red gave red; red ♀ mated with white II ♂ gave red; white II ♂ mated with red ♀ gave white young[3]. But with regard to the behaviour of the red pigment there is a great difference. In Stock II the distinction at birth is clearly marked between a bright red-eye normal body colour, and a white-eye white-body, but in at least three of the new stocks, there is considerable variation in the red-eye colour though the body colour is always normal.

Even in the same brood, the eyes at birth may be bright red, different shades of pink, or cream colour; the reds may lighten to pink or even cream, and the cream develop redness, or they may change but little. At the extreme limit of the change, the eyes are white and indistinguishable from the Stock II 'flushed whites', that is, eyes white with a very faint tinge of colour in two or three central ommatidia, yet they always function as reds. Similar variation in the concentration of the red pigment has already been found in the r_3r_3 types of Stock V, and among the reds known as Flesh[4].

E. W. SEXTON.
A. R. CLARK.

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Jan. 11.

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[1] Sexton, Clark and Spooner. "Some New Eye-colour Changes in *Gammarus chevreuxi*, Sexton." Pt. II. *J. Mar. Biol. Assoc.*, **18**, 1; 1932.

[2] Sexton and Clark. "New Mutations in *Gammarus chevreuxi*, Sexton." NATURE, **117**, 194, Feb. 6, 1926.

[3] Sexton and Pantin. "Inheritance in *Gammarus chevreuxi*, Sexton." NATURE, **119**, 119, Jan. 22, 1927.

[4] Spooner. "An Experiment on Breeding Wild Pairs of *Gammarus chevreuxi*, etc." *J. Mar. Biol. Assoc.*, **18**, 1; 1932.

Distribution of Molybdenum

I WOULD like to supplement Prof. H. ter Meulen's observations on the distribution of molybdenum in Nature[1] by repeating facts which so far have been published only in a preliminary report in a horticultural journal[2].

The character of an apple tree is profoundly influenced by the root system on which it is worked (budded or grafted); a particular variety may be rendered precocious or slow in fruiting, vigorous or dwarf in habit, resistant or susceptible to certain diseases, etc., by suitable choice of the rootstock on which it is worked. So far, it has not proved possible to imitate all these groups of effects by choice of soil and application of manure, but there is a general similarity between the effects of rootstock on one hand and of soil type and manuring on the other. Both soil type and manure are reflected in the elementary (especially the ash) analysis of the plant. It is known that different varieties of the same species of plant growing in the same soil differ in ash analysis, that is, each variety exercises a degree of selection in the proportions in which it takes up elements from the soil. If the rootstock continues to exercise this selective action after it has been worked, it can scarcely fail to exert an influence on the elementary composition of the scion. As a first attempt to apply chemistry to the elucidation of the mechanism of the effect of rootstock on scion, therefore, it was decided to examine the effect of rootstock on the elementary analysis of the scion, to seek for correlations between peculiarities in elementary analysis and horticultural character, and finally to attempt the modification of horticultural characters by modifying experimentally the elementary composition.

Accordingly, trees of the same variety but on two markedly different rootstocks grown close together were in the summer of 1928 separated into various anatomical fractions and 'ashed'. The ashes were examined spectroscopically by Prof. H. Dingle of the Imperial College, London, who reported many quantitative differences between the ashes of corresponding parts of the trees on the two rootstocks and one qualitative one; the six trees on rootstock type ix contained molybdenum, the element not being detected in any of the ten trees on rootstock type xii. In the young trees so far examined, the molybdenum was restricted to the woody parts of the roots and of the stem up to about the level of the graft union, none being found in tissues external to the wood or in any part above the union.

Preliminary experiments in which potassium molybdate was injected into the tops of young trees on rootstock type xii failed to demonstrate any significant effect, but material of varying ages is now ready for injection of molybdates into all parts, including the roots, in the hope of throwing light on the function of the element.

The effect of molybdates on the polarisation of organic acids[3] invites speculation as to the function of molybdenum.

W. A. ROACH.

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[1] H. ter Meulen, NATURE, **130**, 966, Dec. 24, 1932.

[2] Roach, "Annual Report of the East Malling Research Station II, Supplement", 1928–30, 101–110; 1931.

[3] Patterson and Buchanan, *J. C. S.*, 3006–19; 1928.

Fluorescence of *Lolium* Seedlings in Ultra-Violet Light

DURING the past three seasons (1930–32) we have carried out selfing, hybridisation and back-cross experiments with *Lolium perenne* L. and *Lolium multiflorum* Lam. with a view of ascertaining the mode of inheritance of the factors responsible for the ultra-violet light fluorescence reaction. The considerable amount of data now to hand strongly confirms our original expectations[1].

(1) The capacity to fluoresce is heritable.

(2) Normally *L. perenne* is pure for non-fluorescence and *L. multiflorum* for fluorescence.

(3) Fluorescence is dominant in the F_1 generation of the cross, pure fluorescent × pure non-fluorescent.

(4) The F_2 generation gives a ratio not significantly differing from 3 fluorescent to 1 non-fluorescent.

(5) The back-cross F_1 × pure fluorescent gives all fluorescent progeny and the back-cross F_1 × pure non-fluorescent gives a ratio approximating to 1 fluorescent to 1 non-fluorescent.

(6) We have found no genetic linkage between fluorescence and (*a*) the possession of awns on the lower flowering glumes, (*b*) shoot vernation, (*c*) longevity (data limited), or (*d*) vigour (data limited).

A number of these conclusions do not agree with those of Nilsson[2], but some of them are in agreement with deductions derived from 1931 selfing experiments reported by Corkill[3]. In our work the F_1 plants from the crosses *L. perenne* × *L. multiflorum* and vice versa were highly self-sterile; this made genetic analysis more difficult.

The investigation was designed to elucidate the curious fluorescence behaviour of *L. perenne* strains. Broadly speaking, each strain has a constant content of fluorescence reactors (after making due allowance for the admixture of *L. multiflorum* which is present to some extent in most commercial lots). This content is lowest in the case of superior (from an agronomic point of view) and highest in the case of inferior strains. We have examined some sixteen different strains from nine countries and find the correlation distinct and striking. It is particularly noticeable in the case of New Zealand lots [1, 4].

The content of fluorescent reactors thus provides a gauge of agronomic merit. This might be ascribed, at first sight, to the non-fluorescent fraction being *ipso facto* superior to the fluorescent portion in each strain, the latter representing the segregants of *L. perenne* × *L. multiflorum* crosses and the fluorescence being linked to the *L. multiflorum* 'inferior' characters. This theory is, however, untenable, since we have not, so far, found any evidence of linkage between fluorescence and (*a*) biennial habit, or (*b*) growth vigour. Further data are required in this connexion.

An alternative tentative hypothesis, which seems more likely, depends on the assumption that *major* degeneration in *L. perenne* strains is due to hybridisation with *L. multiflorum* in the first instance. There is collateral evidence for this view. These so-called species readily inter-cross, and although the F_1 plants are partially self-sterile, back-crossing takes place without difficulty. Segregants of such crosses are inferior from an agronomic point of view. The proportion of *L. perenne* × *L. multiflorum* heterozygotes present in a strain (and hence the degree of agronomic degeneration) is the resultant of a complex of causes mainly of a cumulative and interdependent nature, and its rate of increase or decrease depends on the balance between the group of influences tending to cause and perpetuate hybrids and the group operating in the other direction. Should equilibrium between these groups be attained (and assuming random mating) the proportions of homozygotes and heterozygotes present in the population would remain constant from generation to generation. This is true in respect of the characters directly governing agronomic value; it is also true of those concerned with fluorescence capacity. On the other hand, should equilibrium be disturbed so as to favour the production and perpetuation of hybrids, then the strain as a whole would deteriorate. But such a deterioration would necessarily be accompanied by an increase in fluorescence reactors. Consequently, the content of fluorescence reactors must be proportional to the degree of hybridisation, and hence of agronomic degeneration. It follows that the fluorescence content of a strain of *L. perenne* is a measure of its agronomic merit, not because the reacting individuals are inferior to the non-reacting ones by reason of linkage with inferior agronomic characters, but because it gauges the amount of *L. multiflorum* 'blood' in the strain as a whole.

In contrast to what we describe above as *major* degeneration, there will naturally be deterioration in cases where unfavourable selective influences act on populations of pure *L. perenne* individuals in the absence of *L. multiflorum* or hybrids. We have no reason to think that such relatively *minor* degeneration can be measured by a fluorescence test.

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[1] *Sci. Proc., Roy. Dub. Soc.*, **20**; 1931.
Comp. de l'Assoc. Internat. d'Ess. de Semences., **18**; 1931.
Thesis for M.Agr. Degree, Queen's University, Belfast, May, 1932.

[2] *Botaniska Notiser*, 1930.

[3] NATURE, **130**, 134, July 23, 1932.

[4] Foy, *New Zealand J. Agr.*; 1931.

Teaching of Biology

I SHOULD like to comment on the account of the proceedings of the Association of British Zoologists, so far as they relate to zoology in secondary schools[1]. I write as a schoolmaster, knowing that my views are to some extent shared by others.

(1) We do not need vacation courses of the type of many now provided. Whereas the university lecturer is usually a specialist, the sixth-form master must have a good knowledge in all branches. Here are the subjects of four questions which have recently been set for schoolboys: the amphibian organiser; the structure, development and function of nephridia; adaptive radiation of insects; ciliary action. I do not complain of these, but I do ask that the universities which set such questions recognise that there are men in the schools who can answer them, and are thirsting for more knowledge of the same standard. I believe the Board of Education uses the term 'refresher course', and refreshes our memories of the dogfish and frog. What we need is instruction in recent advances, and contact with those engaged in research. Much might be done here informally, at least for schools near universities, and formally by the granting of a sabbatical year, in which the schoolmaster could attend a university course. Obviously the latter cannot be realised without the approval of the Board of Education.

(2) I welcome Prof. H. G. Cannon's suggestion that improvement must come through university syllabuses; for pupils who are dependent on scholarships for their college career or on the School Certificate for their livelihood, it is the only way in which it can come.

(3) Few biology teachers have trained laboratory assistants, yet most of us are sent out from the university with no notion of how to do such things as culturing *Amœba* or killing a rabbit, unless we learnt at school. It should not be impossible to

include more 'laboratory method' in a university zoology course, with advantage to others besides the future schoolmasters. Fieldwork—both collecting and ecology—might also have more attention paid to it. Most of what I have written applies, *mutatis mutandis*, to botany also.

W. B. Yapp.

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Jan. 24.

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[1] Nature, **131**, 88, Jan. 21, 1933.

Nuclear Moments of the Gallium Isotopes 69 and 71

An examination of hyperfine structure in the visible lines of the Ga II spectrum with a Fabry-Perot interferometer has shown the patterns due the individual isotopes to be distinctly separated by a difference in the magnetic moments of the nuclei. This permits the mechanical moments to be separately determined as $i = 3/2$ for both isotopes, in accord with previous determinations from incompletely resolved structures in Ga I lines[1] and Ga II lines[2]. The ratio of the $g(i)$ factors, given by the relative magnitudes of the hyperfine term separations, is 1·27, the less abundant isotope 71 having the larger magnetic moment.

These results are obtained from the structures of the $4s5s\ {}^3S - 4s5p\ {}^3P$ and $4s5p\ {}^3P - 4s5d\ {}^3D$ lines. The $4s4d\ {}^3D - 4s4f\ {}^3F$ lines, although not as well resolved, stand in qualitative agreement. The observed structure of the line ${}^3S_1 - {}^3P_0$ λ 6456 is given in Fig. 1, together with the term schemes. The centre of gravity of the 69 triplet, calculated from the theoretical intensities, falls at 0·389 cm.$^{-1}$, that of the 71 triplet at 0·393. Since the difference between these is not much greater than the probable errors in the measurements, it is safe to conclude only that an isotope shift, if present, is very small. The fact that components a' and b, of theoretical intensities 3 c_{71} and 2 c_{69} respectively, are photographed with very nearly equal densities at various exposures, gives the abundance ratio $c_{69}/c_{71} = 1{\cdot}5/1$.

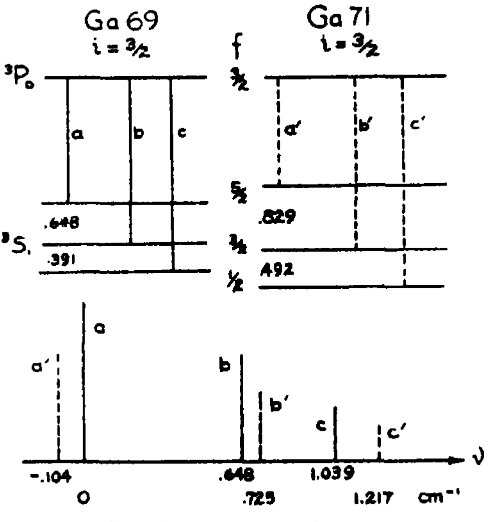

Fig. 1.—Hyperfine structure of λ 6456 in the spectrum of singly ionised gallium. The components due to 69 are indicated with full lines, those due to 71 with dotted lines.

The difference between the $g(i)$ factors observed here is noteworthy in that the only other example of isotopes with equal spins and unequal hyperfine separations is that of thallium, where the lighter isotope (as in the present case) exhibits separations 1 or 2 per cent smaller than those of the heavier isotope[3]. The remaining isotope pairs which have been reported with some certainty to have equal spins are copper 63, 65[4]; bromine 79, 81[5]; cadmium 111, 113[6]; rhenium 185, 187[7]. None of these has shown a perceptible difference in the hyperfine separation constants. It is true, however, that the hyperfine structure of the last four elements named is not so well suited to the observation of small differences as is the structure of the thallium lines, and it is possible that the gallium isotopes are exceptional only in the degree to which their magnetic moments differ.

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Dec. 24.

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[1] D. A. Jackson, *Z. Phys.*, **75**, 229; 1932.
[2] J. S. Campbell, *Phys. Rev.*, **40**, 1040; 1932.
[3] H. Schüler and J. E. Keyston, *Z. Phys.*, **70**, 1; 1931.
[4] R. Ritschl, *ibid.*, **79**, 1; 1932.
[5] S. Tolansky, *Proc. Roy. Soc.*, A, **136**, 585; 1932.
[6] H. Schüler and H. Brück, *Z. Phys.*, **56**, 291; 1929. S. Goudsmit, *Naturwiss.*, **17**, 805; 1929.
[7] W. Gremmer and R. Ritschl, *Z. Instrumentenkde.*, **51**, 170; 1930.

Negative Polarisation in Fluorescence

In an important paper[1] Wawilow has reported measurements on the polarisation of fluorescence of solutions of some dye-stuffs in glycerine, when excited by radiations of different wave-lengths. Using for excitation the radiations from a mercury lamp, isolated by a quartz monochromator, he finds that the degree of polarisation shows a marked dependence on the wave-length of the exciting light. Starting from the visible region of the spectrum, as the wave-length of the exciting light is diminished the degree of polarisation decreases rapidly, passes through a minimum value (corresponding, in general, to excitation by λ 3125–3131), and rises again as we proceed farther towards the ultra-violet. The minimum value is usually *negative*; that is, the intensity of the fluorescent vibrations along the direction of propagation of the incident light is greater than that of vibrations in the perpendicular direction.

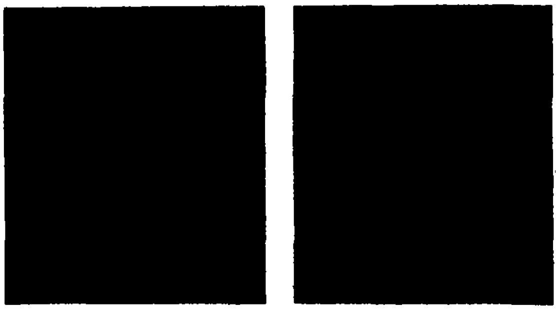
(*a*) (*b*)

Fig. 1.

It is known, however, that the light that issues from a quartz (crystalline) monochromator is, in general, considerably polarised, and that the direction and the extent of polarisation fluctuate as we proceed along the spectrum. We have therefore repeated

Wawilow's measurements using linearly polarised light for excitation and observing along the normal to the plane containing the direction of propagation and the direction of vibration of the exciting light. Though our values differ considerably from those calculated from Wawilow's results (the polarisation varies also with the concentration of the dye-stuff), the general nature of the variation of polarisation with the exciting wave-length, and also its negative value for excitation by λ 3125–31, are fully confirmed. The change in sign of the polarisation in the case of fluorescein solution occurring when the exciting wave-length is changed from λ 4358 to λ 3125–31, is seen clearly in Fig. 1 (*a*) and (*b*), which are photographs of the fluorescent radiations excited by λ 4358 and λ 3125–31 respectively, taken through a suitably oriented Savart plate and analyser. The images of a fixed cross-wire which appear in the photographs, serve as reference for the positions of the fringes. It is easily seen that whereas in Fig. 1 (*a*) the centre of the cross-wire falls on a bright fringe, it falls on a dark fringe in Fig. 1 (*b*).

Also observations along different directions show for λ 3125–31 excitation that the intensity of the fluorescent radiations vibrating normal to the direction of the vibrations of the exciting light is always greater than that of fluorescent vibrations along the direction of the exciting vibrations.

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Dec. 23.

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[1] *Z. Phys.*, **55**, 660; 1929.

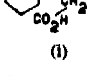
Synthesis of Chrysene and Certain Derivatives

THE very interesting letter of Messrs. Cook, Dodds and Hewett[1] on the subject of the œstrus-producing action of a keto-tetrahydrophenanthrene contains a statement that experiments are being made with the object of converting this ketone into ketohydroxyœstrin.

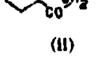
We have also been engaged in synthetic studies in this group for some time and therefore, in the hope of avoiding duplication of research, we take an early opportunity of indicating the lines on which we are proceeding.

The method is similar in principle to that of Braun and Irmisch[2] but the stages are effected in a different manner and the yields of pure products have been greatly improved.

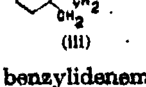
β:β′-Diphenyladipic acid (i) (*meso-* and *rac-*), is accessible in several ways, for example, by reduction of ethyl cinnamate (or benzylidenemalonic ester, etc.) by means of aluminium; it suffers twofold dehydration on treatment with hot 85 per cent sulphuric acid giving the diketohexahydrochrysenes (ii) (*cis-* and *trans-*). Reduction of the *cis*-diketone by Clemmensen's method affords a hexahydrochrysene (iii) the constitution of which is confirmed by its dehydrogenation by selenium to chrysene (iv).



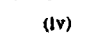
(i)



(ii)



(iii)


(iv)

Starting with the appropriate substituents in the benzene rings (possibly β:β′-dianisyladipic acid will serve the purpose) we can see our way, as clearly as any paper-synthesis allows, to the preparation of a *nor*ketohydroxyœstrin, *that is*, the natural product without its angle-methyl group.

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R. ROBINSON.

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Jan. 31.

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[1] NATURE, **131**, 56, Jan. 14, 1933.
[2] *Berichte*, **64**, 2461; 1931.

Sex Hormones and Cancer-Producing Compounds

A SEQUEL to the formulation of the sterols and bile acids as hydrogenated phenanthrene derivatives[1] was the suggestion[2] that carcinogenic derivatives of 1 : 2–benzanthracene might arise by abnormal sterol metabolism. No experimental evidence for ring-closure to the hydrogenated benzanthracene ring-system has yet been put forward. Whether this actually occurs or not, it seems probable that the formation of a carcinogenic compound from a sterol would involve dehydrogenation to the aromatic state, for reduction of 1 : 2 : 5 : 6–dibenzanthracene to an octahydro compound results in loss of carcinogenic activity. Recent investigations of the ovarian hormones support the view that such sterol dehydrogenations do occur in the animal body. Thus œstrin is a tetracyclic compound which contains one aromatic ring, and Girard[3] has recently isolated from the urine of pregnant mares an œstrogenic compound which undoubtedly contains two aromatic rings.

For reasons such as these, and because the cell proliferation which characterises the œstrous state is in some respects reminiscent of the early stages of a malignant growth, we have sought a correlation between substances having œstrogenic action and those having carcinogenic properties. Four main lines of attack have been initiated. These are:—(*a*) The production of synthetic compounds of known constitution which possess œstrogenic properties. One such substance, 1–keto–1 : 2 : 3 : 4–tetrahydrophenanthrene, has already been described[4]. (*b*) The examination for œstrogenic activity of compounds containing the same ring-system as carcinogenic hydrocarbons, but with polar groups present and with some rings partially reduced. One such compound, 9 : 10–dihydroxy–9 : 10–di–*n*–butyl–9 : 10–dihydro–1 : 2 : 5 : 6–dibenzanthracene[5] has now given positive results. (*c*) In addition, we have found œstrus-exciting activity to be possessed by the two most potent carcinogenic hydrocarbons yet known, namely, 5 : 6–*cyclo*penteno–1 : 2–benzanthracene[6] and 1 : 2–benzpyrene[7]. We confess that this last result was entirely unexpected; it is very striking that both types of biological activity should be shown by one and the same compound. (*d*) The examination for carcinogenic activity of œstrin and related compounds, especially the basic aromatic hydrocarbon 1 : 2–*cyclo*pentenophenanthrene, is being undertaken.

The technique of testing for œstrous activity was that described in NATURE of January 14. The difficulties of solubility of the three compounds reported was very much greater than was experienced hitherto, and in *all three cases 100 mgm.* of substance was injected in a suspension in sesame oil. It is impossible to obtain any idea of the potency of the substances relative to œstrin from these determinations owing to the extremely slow absorption. These tests must therefore be regarded as qualitative reactions for œstrogenic activity, but the results are none the less conclusive. The 9 : 10-dihydroxy-9 : 10-di-*n*-butyl-9 : 10-dihydro-1 : 2 : 5 : 6-dibenzanthracene, when injected in the quantity described above, gave a full œstrous response in all the ten animals injected, and the œstrus is continuing after 150 hours. With regard to the two carcinogenic hydrocarbons, 5 : 6-*cyclo*penteno-1 : 2-benzanthracene gave four œstrous responses lasting 150 hours out of ten animals, whilst 1 : 2-benzpyrene gave three œstrous responses lasting 150 hours out of ten animals. It would appear from these results that these two latter compounds have a feebler œstrus-producing action than the former.

In reporting these very suggestive results, we wish expressly to emphasise that, at the present stage, there is no evidence whatever that carcinogenic compounds arise from œstrin in the animal body. We merely record our observations that pure synthetic compounds of known molecular structure can possess both carcinogenic and œstrogenic activity.

We have commenced experiments (in collaboration with Mr. C. L. Hewett and Mr. W. Lawson) which have as their aim the synthesis of ketohydroxyœstrin and compounds of allied structure.

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Courtauld Institute of Biochemistry,
Middlesex Hospital, W.1.
Feb. 3.

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[1] Rosenheim and King, *Chemistry and Industry*, **51**, 404 ; 1932. Wieland and Dane, *Z. Physiol. Chem.*, **210**, 268 ; 1932.

[2] Kennaway and Cook, *Chemistry and Industry*, **51**, 521 ; 1932.

[3] Girard, *C. R. Acad. Sci.*, **195**, 981 ; 1932 ; **196**, 137 ; 1933.

[4] Cook, Dodds and Hewett, NATURE, **131**, 56, Jan. 14, 1933.

[5] Cook, *J. Chem. Soc.*, 496 ; 1931.

[6] Cook, *J. Chem. Soc.*, 2529 ; 1931.

[7] Cook, Hewett and Hieger, NATURE, **130**, 926, Dec. 17, 1932.

Glutathione, Iodoacetic Acid and Glucose Metabolism

WITH reference to Dr. Dickens's interesting letter in NATURE of January 21 (p. 130) I may, perhaps, be allowed to make a brief statement. My colleague, Mr. A. H. M. Wheatley, and I submitted for publication in the *Biochemical Journal* on November 1 a paper containing the following observations.

(1) The toxicity of iodoacetic acid *in vivo* is greatly diminished or eliminated by admixture with sodium thiosulphate. Iodimetric estimations showed that one molecule of iodoacetic acid combines with one molecule of sodium thiosulphate.

(2) The powerful inhibitory action of small concentrations of iodoacetic acid on the oxidation of glucose by brain tissue is diminished or eliminated by the addition to the brain tissue of glutathione, cysteine or sodium thiosulphate. The evidence showed that there is a direct interaction between the sulphur compounds and iodoacetic acid, the halogen atom of this acid being clearly very labile. Dr. Dickens's observations support this conclusion.

(3) It appeared possible from the evidence that the toxicity of iodoacetic acid towards biological processes might be linked with its ability to combine easily with sulphydryl compounds, and, hence, that the naturally occurring sulphydryl compound, glutathione, might be playing some part in the processes inhibited by the halogen acid. This conclusion was confirmed by experiments on the action of glutathione on the fermentation of glucose by baker's yeast under aerobic conditions. It was shown that the addition of glutathione to baker's yeast increases the rate of carbon dioxide output in presence of glucose to a value approaching that obtained by the yeast under anaerobic conditions. The oxygen uptake, on the other hand, was slightly inhibited by the presence of the sulphydryl compound. Glutathione affects markedly the relationship between fermentation and the respiration of yeast in the presence of glucose.

The observations recorded above were made before the appearance of Lohmann's paper on the influence of glutathione on glyoxalase activity. It is likely that there is a close connexion between the effects of glutathione on glucose breakdown on one hand and glyoxalase activity on the other, and the conclusion seems warranted that glutathione in the living cell plays a dominant rôle in the dynamics of glucose metabolism.

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Cardiff City Mental Hospital.
Jan. 28.

Rate of Burning of Colloidal Propellants

IN NATURE of January 14, A. D. Crow and W. E. Grimshaw have discussed our method of analysing some of their experimental results, and offer the following criticisms :

(1) The method of correcting for energy losses is invalid when applied to differential methods of analysis.

(2) A simplifying approximation we make in calculating the correction leads to serious error.

The first criticism is beside the point, since our method is not a differential method. After adequate trial we discarded both differential and integrating methods and our reasons for doing so are stated in our paper. Our method is a direct method, each point on our curves being based on one observation and one only of pressure and time, independent of previous and subsequent observations. The cooling correction applied at each point is based on the same assumption as that of Crow and Grimshaw, namely, a mean gas temperature holding up to the moment under observation. This assumption is sufficient for the purpose of assessing the energy loss up to this moment, provided the mean temperature does not differ greatly from that at complete combustion. Except for the first two or three observations of each series (which we discard) this condition holds. The resulting corrections to the observations retained are never large enough to mask the effect under investigation.

The simplifying approximation referred to in the second criticism leads to errors of less than one per cent for all observations retained ; the resulting displacement of the points on our curves is imperceptible.

The promise of additional material including temperature observations relieves us of the necessity of pursuing this subject further in its present form.

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Jan. 23.

Research Items

Mother Goddess in India. Mr. Kalipada Mitra discusses in the *Indian Antiquary* for December the affinities of the Gây Ḍâṇṛ festival in its bearing on the cult of the mother goddess in India. It is suggested that it is a survival of a ceremonial sacrifice offered in the past to the corn goddess, especially because of its close association with the terrible goddess Kâlî, her Lakṣmî and Alakṣmî and the Feast of Lamps. A festival known as the *Gârśî Vrata* is observed in several districts of Bengal by women only in the very early hours of the morning on the last day but one of the year for the benefit of the cattle and the household. This is a peculiar form of worship of Lakṣmî. In several districts a clay figure of Alakṣmî is mutilated by cutting off the ears and nose, after which Lakṣmî is ceremonially installed in the house. The offerings made consist of plantains, coconut, etc., but must not include any produce of the ploughshare. In Vikrampur, when the household rises, a conch is blown and a torch is lit and carried into every room while an elderly woman chants verses ordering out vermin and bidding Lakṣmî enter. In eastern Maimansingh this ceremonial is regarded as some sort of worship of a deceased mother-in-law. An effigy of the mother-in-law in the form of a rice-paste female figure with a babe in her lap, accompanied by rice-paste figures of four kites and four crows with the effigy of a pig, is set up by a small tank dug in the courtyard for the purpose. When the pig has been sacrificed to the female figure, she with the other figures are buried in the tank. This ceremonial seems to lead up to the ancient cult of the mother goddess. Similar figures in terracotta have been found at Patna, Buxar and Kumrahar, through which both in form and association connexion is here traced with the figurines of Mohenjo-daro and Harappa as well as with the mother-goddesses of Sumer and Crete.

Late Neolithic Fortress, Homolka, Bohemia. A preliminary report on the excavation of a late neolithic fortress at Homolka in Bohemia by the second and third archæological expeditions to Central Europe of the Peabody Museum, Harvard University, and the University Museum of Philadelphia, in the seasons 1930, 1931, is made by Vladimir J. Fewkes (*Proc. Amer. Phil. Soc.*, 71, No. 6). A preliminary reconnaissance in 1929 tested nineteen sites in Bohemia which yielded evidence of fourteen different cultural phases from the earliest neolithic to twelfth century Slav. The top of Homolka resembles a roughly pointed horseshoe, greatest length a little less than 100m. and greatest breadth 60m. It belongs to the so-called 'Nordic' phase of neolithic culture, approximately 2,000–1,800 B.C., and represents the closing stage of the neolithic in this part of Europe. One hundred and forty-seven culture pits, representing for the most part dwelling-foundations, were excavated. Nineteen definite huts, indicated by well-defined traces of posts, were found. Pits and post-holes were cut in shale. Huts ran in rectangular shapes, approximately 4·25–6·50 m. in length and 3–5 m. in width. Three rows of posts, two walls and a centre line supporting the ridge pole are characteristic of the earlier huts. Sub-pits, three or four in number, are usual, their purpose being distinguishable, such as fire-pits, work-shop with anvil, etc. Fireplaces of clay, or in one case with a pebble-bed, and, possibly, traces of benches were observed. The walls were plastered on light parallel poles. There is no evidence of wicker-work of wattle and daub. Two palisades, belonging to different periods, were present. Pottery was found in large quantities, and is now being studied with important results. The oldest type shows affinities with Jordansmühl. Later, innovations were introduced from both south and north. Quantities of bone and antler work and shells from the Mediterranean or Adriatic were found. The site is a unique archæological monument in Central Europe.

Effect of Pit-Head Baths. The *Human Factor*, vol. 6, No. 12, contains an article on "Pit-Head Baths", by Mr. J. H. Mitchell, who is the holder of a Miner's Welfare national scholarship, and qualified to speak from personal experience. He sketches the origin and development of the scheme, and the reasons and prejudices behind the miners' initial rejection of it. These, he alleges, are, their fundamental conservatism, natural opposition to the necessary weekly deduction from wages, and a host of curious yet real objections, such as distrust of the employers' real intentions, and fear of too much washing. He gives a clear exposition of the installation of the baths, and the procedure adopted, and details the far-reaching effects, both observed and to be expected. Six months after their inception, lost time due to sickness and accidents was definitely decreased, although voluntary absenteeism (for reasons he explains) had arisen. Demands for overtime are frequent and unforeseen in the industry, and the invigorating effect of the bath facilities have proved physically and psychologically invaluable. Mr. Mitchell foresees, as a consequence, a great change in the miner's home life.

Birds of the Natuna Islands. The Natuna Islands extend for some two hundred miles in the South China Sea, north-west of Borneo. They comprise a few main islands, with numerous islets and rocks. Ornithological knowledge of the Islands dates from 1893, and now Harry C. Oberholser reviews all the information bearing upon the birds of this interesting area (Smithsonian Institution, *U.S. Nat. Mus.*, *Bull.* 159, 1932). The fauna is of the continental island type, its relationships being with the other islands of the South China Sea and the neighbouring land masses. Of 108 breeding species and sub-species (19 species occur as migrants only) 26 are peculiar to the Islands, their nearest relatives being in Borneo (12), the Malay Peninsula (11), Sumatra (9), the Anamba Islands (4), and Java (2). Of the 76 remaining forms, some are confined to a limited East Indian area, while others have a wide range in the Oriental and Australasian regions. Analysis shows that the birds of the Natuna Islands are most closely related to the fauna of Borneo, less closely and about equally to the faunas of the Malay Peninsula and Sumatra, about half as much to Java as to Sumatra, still less to the Anamba Islands, and least of all to Indo-China.

Nerve-Net of Hydra. Carl H. McConnell (*Quart. J. Micr. Sci.*, 75, Pt. 3, 1932) has traced the development of the ectodermal nerve-net in the buds of *Hydra*. After trial of various methods of vital staining, he adopted the rongalit white technique, which is carefully described. The nerve cells develop from the interstitial cells of the ectoderm and by the time the tentacle area makes its appearance in the bud, the interstitial cells which are to become nerve cells begin to send out processes between the epithelio-muscular cells of the newly forming ectoderm, and as further development proceeds a small area of nerve-net is formed by the growing together of processes from the ganglion and sensory cells. These processes advance in a pseudopod-like manner between the epithelio-muscular cells until they meet and fuse with processes from other ganglion cells. Other processes from the ganglion cells grow out in various directions and end among the muscle processes of the epithelio-muscular cells but there are no differentiated nerve endings. It appears that the long connecting processes develop first and the short, free-ending motor processes later. The author states that on many occasions he has been able to observe a perfect net under the epithelium of brown *Hydra* but the connexions between the nerve elements are easily broken by pressure of the cover-glass. The development of the nerve-net proceeds downwards from the tentacular to the basal or foot pole of the *Hydra*. The author found no connexions between the nerve cells and the cnidoblasts. He figures developing sensory cells and developing and fully formed ganglion cells, bipolar and multipolar.

Eradication of the Stinging Nettle. The distribution and control of the great stinging nettle, *Urtica dioica*, is the subject of an interesting article by G. H. Bates in the *Journal of the Ministry of Agriculture*, vol. 39, p. 912. Although not an arable weed, this plant frequently becomes troublesome on grass, and apart from any other reason it gives a general appearance of neglect on property where it occurs in any great quantity. A careful study of the chief natural habitats of the nettle have led the writer to refute the old idea that it is a nitrophilous and shade-loving plant and actual soil analyses are brought forward in support of his view. Cover, rather than high nitrogen content, was found to be characteristic of the sites most liable to infestation, and the chief causes of an invasion of nettles on grassland, molehills, stick heaps, ditch clearings for example, bear out this theory. As regards the best methods of eradication of nettles from grassland, opinion is somewhat various, but both chemical and mechanical means have been used successfully. As an example of the first type of method, spraying with a 5 per cent solution of sodium chlorate may be mentioned. This has proved very successful on the Continent and should be applied at the rate of 1 gallon per square yard after the shoots have been cut down so as to ensure the underground parts of the plant being reached. A simple but effective mechanical method of eradication is cattle treading. The placing of a feeding trough or salt lick in the middle of a patch of nettles has been shown to bring about a complete clearance of the pest, and the consolidation of the ground only temporarily affects the grassland itself.

Pitchblende at Great Bear Lake, Canada. It is already well known that the pitchblende deposits at LaBine Point, though difficult of access, probably constitute the most valuable source of radium yet discovered. A comprehensive report on the occurrences has been prepared by H. S. Spence (Investigations of Mineral Resources and the Mining Industry, 1931, pp. 55–92, 1932, Department of Mines, Canada). Four types of mineralisation have so far been found: (*a*) pitchblende-quartz veins with important amounts of native silver; (*b*) native-silver-rhodochrosite veins; (*c*) silver-cobalt-carbonate veins; and (*d*) cobalt-bismuth-quartz veins. Of these, (*d*) is definitely later than the others, the relative ages of which have not yet been established. Samples of pitchblende taken at a dozen different openings on the two principal veins, representing roughly hand-graded ore, have been analysed in detail. They show 25·73–52·68 per cent of uranium and 5·82–13·40 per cent of lead. Atomic weight evidence has proved that the lead is almost pure uranium lead, corresponding to the facts that thorium is absent from the mineral and galena no more than a very rare accessory. The age of the pitchblende is estimated at about 1,300 million years, a figure which presumably implies an early Pre-Cambrian (Keewatin) period of ore deposition. It is of interest that the samples giving the lower values for uranium are leached surface specimens. The presence of rich deposits of native silver adds additional interest and economic value to the occurrences.

Rainfall in Dahomey. "Die Niederschlagsverhältnisse des alten deutschen Schutzgebietes Togo" is the title of a memoir by Dr. Raoul Pignol which is No. 6 of Band 49 of *Archiv der Deutschen Seewarte*, but is published separately. It deals with the climate—more particularly the rainfall—of what used to be the German colony of Togoland. The greater part of this area is now incorporated in Dahomey. On a basis of rainfall and temperature, following the system of classification of climate devised by Köppen, the country must be divided into three principal zones, which show characteristic vegetation. The southern coastal belt has two rainy seasons separated by a short, dry season in summer and a relatively long one in winter, and is classified as isothermal (annual range of temperature less than 5° C.); from the northern boundary of this zone up to about latitude 8°, the isothermal character is maintained, but in general there is only one wet and one dry season, the dry season extending from November to February or March; farther north the annual range of temperature exceeds 5° C. and the dry season is longer, extending from October or November to April or May. The rainy and dry seasons occur, according as the monsoonal indraught from the Gulf of Guinea or the dry harmattan—a north-east wind drawn from the Sahara—prevails. The analysis of the available rainfall data has been carried out with Germanic thoroughness. The different types of seasonal variation of rainfall are illustrated by graphs for representative stations, and these are followed by the main objective of the work—rainfall maps on a good open scale, showing the geographical distribution of annual, seasonal and monthly rainfall. Apart from their economic value, these are instructive examples of the monsoonal control of climate, and may usefully be compared with similar data for India.

Aeroplane Noises. The issue of the *Proceedings of the Physico-Mathematical Society of Japan* for October 1932 contains the second of two papers on the sounds emitted by revolving air screws which Messrs. Obata, Morita and Yosida have recently contributed to the Report of the Aeronautical Research Institute of Japan. Models, of about a third natural size, of six air screws were used. The driving shaft projected through the outer wall of a building from a boxed-in electric motor and the sounds were recorded by microphone, amplifier and oscillograph. They are of three types—those due to the rotation of the screw, those due to the shedding of eddies from the blades and those due to the elastic vibrations of the shaft and blades. The oscillograph records are not strictly periodic but a representative period is analysed and the amplitudes of the component harmonics at different speeds of the screw and in different directions from it, are shown by means of curves. Full-scale observations on a moored aeroplane provided with a silencing pit were made for the Aircraft Noise Sub-Committee of the Aeronautical Research Committee in Great Britain by Mr. C. F. B. Kemp and were described by him in the March 1932 issue of the *Proceedings of the Physical Society*, London. His results are in partial accord with the theory of Dr. Paris while those of Obata, Morita and Yosida are not.

Polarisation Phenomena in Electron Scattering. E. Rupp has described further experiments on the polarisation effects obtained by scattering electrons at gold surfaces (*Phys. Z.*, Dec. 1). In his earlier experiments, the electrons scattered at 90° by a gold foil were passed through a second thin gold foil and an intensity variation was found around the ring pattern. The latest experiment was conducted by scattering the electrons by a gold foil and allowing a pencil of electrons scattered by a gold foil to fall alternatively on a gold or an aluminium wire which acted as a second scatterer. The electrons leaving the wire in two directions parallel and antiparallel to the original electron beam were separately collected. The apparatus was adjusted until the ratios of parallel to antiparallel scattering were equal for the gold and aluminium wires, using 20 kv. electrons which were assumed not to show polarisation. When 130 or 250 kv. electrons were used this equality was not maintained, a polarisation effect altering the ratio by 3–4 per cent and 9–10 per cent respectively. The polarisation effect was destroyed by passing the electrons through a transverse magnetic field 10 cm. long and of intensity 440 gauss. (The direct deflection was compensated electrostatically.) The unsymmetrical reflection is ascribed to a magnetic moment of the electron, and its polarisation to scattering at the atomic nuclei.

Astronomical Topics

Large Group of Sunspots. A large group of sunspots in stream formation is at the present time crossing the sun's disc. The spots appeared at the eastern edge of the disc on February 1 and will disappear around the western edge on February 14; the date of central meridian passage was February 7·5. On February 2–3, the total area of the stream was 1500 millionths of the sun's hemisphere, and the area of the largest component (the following spot) about 700 millionths. This group is the largest for two years, and its appearance at the present time is an example of the vagaries of sunspots. During the last three years, the sun's activity has been declining fairly rapidly towards the minimum of the 11-year cycle, and last year on about ninety days the sun was entirely free from spots; yet the present sunspot disturbance is the third considerable group seen in the last three months. An interesting feature of this group is the inclination (about 20°) of its axis to the sun's equator, the leader spot, in latitude 16° N., being farther away from the equator than the follower in latitude 11½° N. On February 2, the spots were active spectroscopically, and two small eruptions of bright hydrogen ($H\alpha$) were observed at Greenwich at 10^h and 15^h.

Perturbations of Comets by the Stars. A paper by E. Opik (*Proc. Amer. Acad. Arts Sci.*, Oct.) examines the effect of stellar perturbations in the case of comets or meteors which travel to great distances from the sun. It is easy to see that, since it is only the difference of action on the comet and on the sun that is effective, it is necessary to proceed to great distances before these perturbations are of any importance. It is shown that one of the effects of such perturbations is a tendency to increase the perihelion distances of the objects; it is concluded that if the aphelion distance is about ten thousand units, or one-thirtieth of the distance to the nearest star, the perihelion distance is likely to be so much increased that few, if any, of such comets would come into the sphere of visibility from the earth. Some 2,000 units is estimated as the probable greatest aphelion distance of the comets that can be seen from the earth; for meteors the lower figure of 1,000 units is adopted. If such meteors date back to the origin of the solar system, estimated to have been some 3,000 million years ago, they would have approached the sun more than a hundred thousand times; the heat experienced is estimated as equivalent to about thirty thousand years of continuous heating to a temperature exceeding 0° C. This would, according to the author's estimation, suffice to deprive a stony meteor of all its helium. This research, which is of a novel character, was undertaken in connexion with the extensive meteor work initiated at Harvard by Prof. Shapley.

Spectral Types of Faint Stars. Kapteyn's plan of "Selected Areas" included the determination of the spectral types of as many stars as possible in each area. Part of this work of classification was undertaken by the Mount Wilson Observatory, and a list of 4,066 spectral types has now been published by Dr. Humason (*Astrophys. J.*, vol. 76, p. 224). These cover the first 115 areas of Kapteyn's plan, and include stars down to the 15th magnitude (photographic). The observations were made with a slitless spectrograph at the Newtonian focus of the 60 in. reflector, which gave spectra of 7·84 mm. length from $H\beta$ to $H\epsilon$. These spectra were classified by matching with plates of standard stars, the mean of three observations being adopted as the spectral type. The principal criteria used were the hydrogen lines, the [*H*] and [*K*] lines of calcium, the [*G*] band and the *M*-type bands. The only difficulties encountered were in distinguishing between types *F* and *B*, which strongly resemble each other in such small-scale spectra if they are not strong enough to show the [*H*] and [*K*] lines. In addition to the list of observed spectral types, the author includes some statistical notes, with frequency curves for each type in different regions and for all regions together.

Royal Society Mond Laboratory

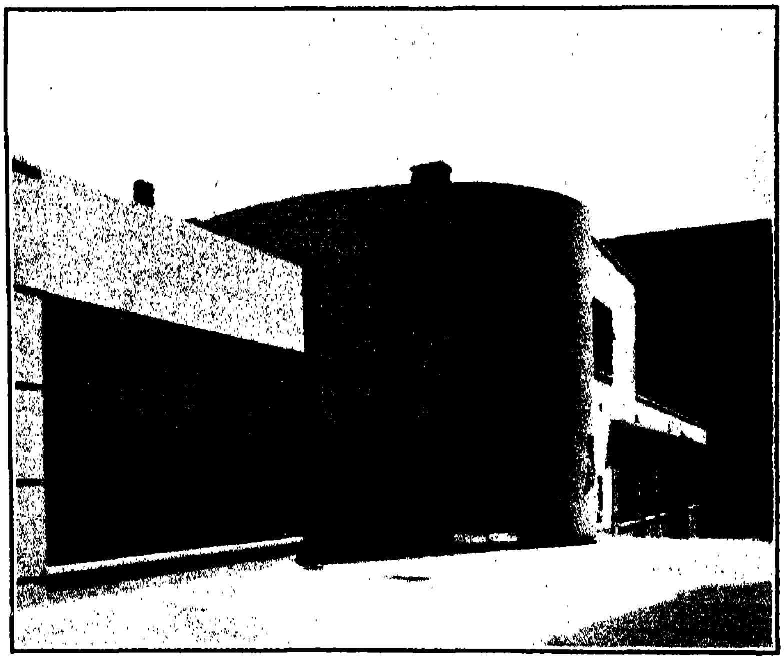
THE new Royal Society Mond Laboratory (Fig. 1) which has been presented to the University of Cambridge by the Royal Society was formally opened on February 3 by the Chancellor of the University, Mr. Stanley Baldwin.

The ceremony was preceded by an official luncheon in Corpus Christi College, given by the Vice-Chancellor, Mr. W. Spens, who welcomed a large gathering representative of the Royal Society, the Department of Scientific and Industrial Research and most of the schools of physical science in Great Britain. After the luncheon, a meeting was held in the Arts School when the Cavendish Professor, Lord Rutherford, explained the purpose of the laboratory and gave an account of the early stages of the work of Prof. P. Kapitza, referring in particular to the great difficulties at the outset, when for a time it seemed almost impossible to construct coils which would not be disrupted by the large electromagnetic stresses developed during the experiments.

Sir Frederick Gowland Hopkins, president of the Royal Society, then formally presented the laboratory to the University. He referred to the connexion which has always existed between the Royal Society and the University, a connexion which has been particularly helped by the sequence of Cavendish professors who have also been presidents of the Royal Society. It was his privilege to convey this gift from an ancient but progressive scientific society to a still more ancient but no less progressive university.

Sir Robert Mond then gave a short address and spoke of the great interest his father, Dr. Ludwig Mond, had always shown in scientific research, an interest which was largely responsible for enabling Dewar's pioneer researches in low temperatures to be carried out and is now bearing further fruit in this gift, which the Royal Society has been able to make from the accumulated interest of the Ludwig Mond bequest. The Chancellor, in accepting the gift on behalf of the University, gave a brief account of the history of the work which has led to the construction of the Laboratory. After several years of preliminary experiments in the Cavendish Laboratory, Dr. Kapitza was able in 1925 to develop a method of producing magnetic fields of the order of 300,000 gauss by passing the heavy initial current from a short circuited alternator through a small coil. To obtain the large currents of the order of 15,000 amperes necessary for the work, a special alternator was required and its purchase was made possible by generous grants from the Department of Scientific and Industrial Research, which was farsighted enough to see the importance of the work and to support it during its infancy. The Department later provided the grant which enabled a liquid hydrogen plant to be constructed and thereby enabled cryogenic work to be taken up again in England after an interval of many years since Dewar's experiments.

The Chancellor reminded his audience that the greatness of a country in the eyes of the world and of history will be measured not so much by the size of its armaments or of its industries as by its permanent contributions to art, literature and science. Modern industry is becoming more and more dependent on the application of discoveries in pure science, and successful industrial research is ultimately dependent on the vigorous prosecution of research in pure science. Whilst as a statesman he would accept no responsibility for the social effects of any work which might come from the Laboratory, as Chancellor he welcomed the gift for the great addition which it makes to the facilities available for experimental physics in the University.



Copyright: H. C. Hughes

FIG. 1. Entrance to Royal Society Mond Laboratory

The new laboratory, designed by Mr. H. C. Hughes, stands in the courtyard of the Cavendish Laboratory. It has been fortunate indeed that soon after the gift of the Royal Society had been accepted, it became possible for the University to build new lecture rooms for the Department of Engineering, and so to clear away from the Cavendish site the old engineering workshops in which the School of Engineering in Cambridge was born, thereby enabling the site to be allotted to the new Laboratory. This close proximity of the Laboratory to its parent body, the Cavendish Laboratory, cannot fail to facilitate and invigorate the work of the Laboratory, since its work is, and must continue to be, mainly physical, whilst the provision of cryogenic facilities may well exert a marked influence on the future work of the Cavendish Laboratory.

Surrounded on all sides by high buildings, the Laboratory has been designed for the most part as a single storey block with a group of first floor rooms for offices at one end. The basic idea of the plan has been to separate and isolate, so far as possible, the research rooms from the heavy machinery which is necessary to the work of the Laboratory. The central hall shown in the plan (Fig. 2) is devoted to the main experimental apparatus of the Laboratory —the large generator which produces the very intense currents and its auxiliary apparatus. Near the generator in adjacent rooms are arranged the machine room, workshop and liquid air room. In these rooms great care has been taken to reduce the noise produced by the machinery at its source by the free use of asbestos sound absorbent; special precautions have been taken to prevent the transmission of noise through doors, and in addition, the steel frame of the building has been erected in two separate sections so that there can be no direct transmission of vibrations from the machine end to the research end of the Laboratory. The roofs of the two sections overlap and only lead aprons, a mortar joint filling and two insulating pads join the two sections. The result of these precautions has been very satisfactory, the noise of the machines and liquid air plant being practically inaudible in the rest of the laboratory.

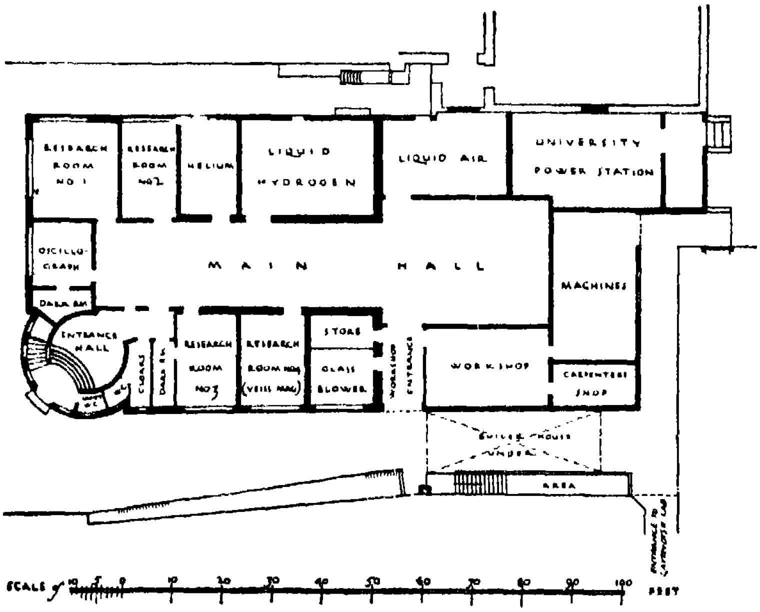


FIG. 2

The liquid hydrogen plant already described in NATURE (129, 224, Feb. 13, 1932) has been removed to the new Laboratory, the only change made being in the system of gas storage. In place of cumbersome oil-filled gas holders which are usual for this work, a very small gas holder is used having a capacity of about 1 cubic metre, the main volume of the gas being stored at 10 atmospheres pressure in hollow steel forgings, automatic pumping plant being installed to convey the gas from the storage cylinder to the gas holder as required. In this way it is hoped to minimise the diffusion of air impurities from the oil of the gas holders into the hydrogen, one of the most common sources of trouble in liquefaction work. A further advantage lies in the great reduction of space effected, and as a result it has been possible to house both a hydrogen and helium liquefaction plant in a room about 25 ft. × 18 ft. The compressors and storage system for the helium liquefaction are installed, and it is hoped to construct the liquefier within the next few months.

The six research rooms of the Laboratory open out of the main hall at the north end. Each research room has large plate glass windows with adequate dark blind arrangements; the walls are plain distempered brick with vertical wooden strips to provide fixing accommodation for apparatus; the rooms are heated by panel radiators fixed on the ceiling to economise floor space. An even temperature is ensured in all the research rooms, first by fitting thermostatically controlled valves to all radiators, and secondly by having an oil-fired boiler with thermostatic control of the water temperature.

In each room a concrete galvanometer foundation goes down to a depth of 10 ft. and heavy section earthing rods should ensure that independence of extraneous electrical disturbances which is so essential for magnetic researches. A cross-connexion switchboard in the main hall enables any one of five different machines to be connected to and controlled from any desired room; at the same time each room has available a separate switchboard on which are a 220 volt battery, four terminals which can be connected to any desired cells in a 110 volt battery, a three wire automatically regulated 110/220 volt D.C. supply, a four wire 3-phase A.C. supply and a galvanometer lamp supply. From the switchboard an overhead grid allows the supply to be conveyed neatly to any table in the room. Self-starting synchronous clocks have been installed in each research room in place of the half minute impulse clocks, to eliminate the magnetic disturbances which are apt to be introduced by the impulse type. All the synchronous clocks are fed from a central point near a master clock which is fitted with both synchronous and impulse dials, and a frequency change arrangement enables all the clocks to be actuated from this point should a failure of supply lead to stoppage. The master clock is also used to provide seconds impulses to any room if required.

Every advantage has been taken of the flexibility allowed by modern building materials to meet the special requirements of the Laboratory at the least possible expense. As a result, the average cost has been less than 1*s*. 3*d*. per ft. cube, of which 10 per cent was for special foundations. The main decorative features of the interior are the attractive modern furniture designed by the architect, Mr. H. C. Hughes, and the gay colourings of the pipes conveying the different services. The only decorative feature of the exterior is the crocodile rampant excised in the white bricks by Mr. Eric Hill. Of the many explanations of the significance of this carving, we may record one—to the sculptor at least it signifies "Science Devouring Culture". The exterior of the building has been faced with white Leighton Buzzard bricks; these together with the large plate glass windows and circular entrance give the building a modernist character, whilst at the same time its simplicity should enable it to be a harmonious neighbour to its very mixed surroundings.

International Congress of Scientific and Applied Photography[*]

THE first International Congress of Photography was held in Paris in 1889. Congresses followed at Brussels in 1891, Paris in 1900, Liège in 1905, Brussels in 1910, Paris in 1925, London in 1928 and Dresden in 1931. It is hoped to continue the meetings triennially and the next one will probably be held in America in 1934. The recently published report of the proceedings of the eighth Congress affords a very good view of the activities of the organisation.

Standardisation of photographic sensitometry has since 1925 been one of the principal objects of the Congress. National committees for dealing with this problem have been set up in Germany, England, France and the United States. After discussions and researches lasting over three Congresses, agreement has at length been reached on a photographic unit of daylight for the testing of such materials as are to be used in daylight. The standard approaches very closely the quality of mean noon sunlight at Washington, and intensities are to be expressed in visual candles. The standard light is comparatively easy to reproduce in the laboratory since it consists in a vacuum electric lamp operating at a colour temperature of 2,360° K. and corrected by means of a two-cell liquid filter of blue colour. The filter is one of a series worked out with great care by Messrs. Davis and Gibson of the Bureau of Standards at Washington and is easily prepared. In other details of the technique of sensitometry a series of recommendations has been drawn up. Thus the methods of obtaining the characteristic curves of photographic materials have been largely unified. The interpretation of the data is, however, not nearly so clear to define; the real meaning of photographic 'speed' is still a matter of great difficulty. The German section of the Congress is, however, making a bold attempt to standardise a method for the determination of commercial speed numbers. This will be very difficult because, although the standardisation of the methods of determining characteristic curves of photographic materials is now within sight, the derivation of 'speed' numbers from the curves is still a subject of acute controversy.

For cinematography the Congress also yields opportunities for achieving international standardisation in such matters as the dimensions and spacing of sprocket holes in film, the definition of the meaning of the term 'safety film', etc.

The chief interest of the Congress lies, however, in the scientific papers presented for discussion. It is interesting to watch the growth or decline of interest in various subjects from one Congress to another. The subject of sound-recording claimed only two short communications in the Congress of 1928. At the 1931 Congress, however, eight papers of considerable scientific importance dealt with various aspects of sound-recording. In 1928 the sound film was in its infancy, by 1931 it had grown out of recognition, indeed it has been said that the number of investigators studying this subject is four times as great as the number studying all other branches of photography. The exact number may be founded mainly on guess work, but the general truth of the statement probably stands.

For research in chemistry and physics, photography appears to serve the function of providing endless themes. It is worth noticing that several papers were communicated from various continental universities and technical institutes. Only two research papers were sent in from England; these emanated from laboratories maintained by the photographic industry. It may be suggested that workers in university laboratories would gain a great deal of inspiration by a careful study of the possibilities presented by photographic science as a field for research.

S. O. R.

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[*] Bericht über den VIII Internationalen Kongress für wissenschaftliche und angewandte Photographie. Dresden, 1931. Pp. 445. Johann Ambrosius Barth, Leipzig.

Electrolysis of Boron Hydrides

IN a communication to the November issue of the *Berichte der deutschen chemischen Gesellschaft*, Herren A. Stock and E. Wiborg discuss the mechanism of the complex changes whereby substitution of hydrogen by amino-groups takes place when solutions of boron hydrides in liquid ammonia are electrolysed. Two distinct reactions have been traced, namely, one which produces hydrogen as the only gaseous product and one which results in the liberation of hydrogen at the cathode and nitrogen at the anode.

These two reactions have been studied in detail. The former predominates for a time but gradually dies down until eventually it is completely replaced by the latter. This stage is indicated by the settling down of the current to a constant minimum value. Solid substitution derivatives can be recovered from the solutions by evaporation of the solvent. These solids were hydrolysed in order to determine their composition. Analysis of the results shows that the hydrogen which is liberated in the first reaction is due principally to chemical substitution of hydrogen by amino-groups but that this substitution is initiated and maintained by electrolysis of the boron hydrides. The other reaction is ultimately due to the electrolysis of ammonia, but as pure liquid ammonia is scarcely affected by the current, it is evident that in this case also some secondary factor has to be considered.

The authors have previously shown that boroethane, B_2H_6, acts as a dibasic acid and they are now able to trace the gradual cessation of the first or substitution-reaction to the diminution of acidity by the formation of inner salts of the amino-derivatives (after the manner of glycocoll). Some of these inner salts will still be sufficiently acidic to undergo further electrolysis and subsequent substitution, whilst others will be neutral and therefore resist further action. Thus the substitution reaction gradually fades out.

Again, the active factors in promoting the direct electrolysis of the ammonia (that is, the final reaction) are said to be the anions of the inner salts, since decomposition of ammonia is not observed in the early stages of the electrolysis. Boroethane gives rise to the compound $B_2H_4(NH_2)_2$ as the final product of substitution.

The compounds B_4H_{10} and $B_{10}H_{14}$ were also studied under similar conditions, when it was found that replacement of six and twelve hydrogen atoms respectively could be effected.

University and Educational Intelligence

CAMBRIDGE.—The Buildings Syndicate has recommended to the University that the plans for buildings for the Department of Zoology prepared by Mr. J. Murray Easton be approved and that Dove Brothers' tender of £72,363 for the work be accepted. If approval is given to this report at the earliest possible date, the first section of the new Zoological Laboratory should be ready for occupation by October 1, 1933 and the whole by October 1, 1934.

At Jesus College, Dr. H. Spencer Jones, formerly a fellow of the College, and recently appointed Astronomer Royal in succession to Sir Frank Dyson, has been elected to an honorary fellowship.

THE Royal Technical College, Glasgow, succeeded last session in fully maintaining its activities despite the continued depression in many of the industries in Glasgow and its neighbourhood. Statistics given in the recently published annual report show that the number of day students (897) falls short by less than one per cent of the number in the preceding year and evening students numbered 2,728, as against 2,880 in 1930–31. The very difficulties which the College has been called upon to face appear to have increased rather than diminished its vitality, and the financial position is satisfactory. Among the notable events of the year was the establishment of a series of bursaries to enable distinguished evening students of the College, whose higher education has been gained while they were at work during the day, to continue their studies by attendance at College day classes, thus helping to remedy one of the defects of the British system of technical education to which attention was directed in NATURE of December 24. Substantial progress was made with the erection of a five-foot diameter open-jet type wind tunnel, intended for the investigation of problems in general engineering as well as in aerodynamics. When completed, the installation will, it is anticipated, be unique in its range of applicability.

Calendar of Nature Topics

Commencement of Salmon Season

February 11.—"The trout and salmon, being in season, have . . . their bodies adorned, the one with such red spots the other with such black or blackish spots, as give them such an addition of natural beauty, as I think, was never given to any woman by the artificial paint or patches, in which they so much pride themselves in this age." (Walton, "The Compleat Angler".)

Walton is much less voluble than usual over the technicalities of angling in his discourse on the salmon. Probably his practical acquaintance with salmon fishing was limited. His account of salmon natural history, however, indicates the main lines of its life-history well enough, despite errors in detail such as August for the spawning month, and the notion that the growth "out of their lower chaps, not unlike a hawk's beak" develops after spawning is over. Apart from more precise determination of systematic relationships among the Salmonidæ, progress since Walton's day has consisted largely in elucidating details of salmon movements, reproduction and growth. The most notable modern contribution is the discovery and utilisation of the fact that valuable information may be deduced from examination of the scales. Migration or marking experiments which, practised on a considerable scale during the last few decades, have yielded much, are a modern development of what seems to be a fairly old practice. "Much of this has been observed by tying a ribbon, or some known tape or thread, on the tail of some young salmons which have been taken in weirs as they have swimmed towards the salt water, and then by taking a part of them again, with the known mark, at the same place on their return from the sea." (Walton.)

Salmon Disease

Increasing attention to fisheries, following on the interest aroused in fish hatching as a means of keeping up stock in rivers, brought 'salmon disease' into prominence. This disease, now known for about a century, is marked externally by growths of the fungus *Saprolegnia ferax*. Day ("British and Irish Salmonidæ", 1887) records it as epidemic in British waters since 1878, and suggests various causes predisposing to the infection, which he considered as normally present but "requires a soil suitable to its germination". Hume Patterson (Rep. Scot. Fish. Bd., 1903) showed the fungus masked a bacillus (*B. salmonis pestis*) the essential organism of the disease. There is still considerable though varying mortality among salmon from this cause and from time to time it has broken out in epidemic force.

Furunculosis

Furunculosis is a more serious disease and lacks the notable external sign of secondary growth of fungus. Essentially a general infection, at present nothing short of bacteriological examination of the blood of suspected fish can give a trustworthy diagnosis, although external lesions may in some cases indicate that the disease is probably present. Emmerich and Weibel (1894) isolated the causative organism (*B. salmonicida*) and their findings were confirmed and extended by Hofer (1904) and Plehn (1909–24) on the Continent; in Great Britain by Arkwright (1912), Horne (1928), and Williamson (1928–30). The disease has been known in Europe for some forty years. In the United States it came under notice rather later (Marsh, 1902). Widespread outbreaks occurred in 1909–11 in France, Switzerland, Austria and south Germany, where in 1909, 25 Bavarian rivers held diseased fish. In 1911 furunculosis reached the south-western English rivers; less than two years after there was an outbreak in Ireland (River Liffey). Since then the disease has been reported in many British rivers. A severe outbreak among Kennet trout in 1924 prompted renewed inquiry into the origin and spread of the disease. In 1926 the finding of 459 dead salmon in the upper waters of the Tay, in what would appear to be an exceptionally favourable environment for salmon, attracted the attention of the Scottish Fishery Board to the disease, which has since appeared in many widely separated Scottish rivers. In 1929 a Furunculosis Committee was appointed by the Minister of Agriculture and Fisheries and the Secretary for Scotland and in the following March an interim report was issued. The Committee found the probable immediate origin of the disease to be fish farms, whence the bacillus may be carried to different rivers by apparently healthy trout distributed for stocking purposes. *Unhampered importation of supplies* from the Continent by such farms, as has occurred freely in the past, provides an easy route for the transmission of infected foreign fish.

That the English outbreak of 1911 should have followed the severe epidemics in Europe in 1909–11 is very suggestive. Transmission by casual migrants from Continental to British rivers must be excluded in view of the low viability of *B. salmonicida* in sea water (Williamson, 1928). It is therefore extremely likely that furunculosis is another case where the incautious introduction of livestock from abroad has done serious harm to the home fauna.

St. Valentine's Day. The Beginning of Spring

February 14.—Several English and French proverbs associate the beginning of spring with St. Valentine's day, when "winter's back breaks". Long-period averages for London confirm these sayings, showing that after remaining almost constant throughout January and the first half of February, the temperature begins to rise about the middle of the latter month. Persistent frosts rarely continue unbroken after this date, and even if the nights remain cold, the increasing power of the sun's rays is noticeable in a midday thaw. The crocus is expected to blossom about February 14, and is dedicated to St. Valentine.

Progress of Oceanography

On February 14, 1779, Capt. James Cook, F.R.S., was murdered by the natives of Owyhee, and the world thus lost at the early age of fifty-one years its greatest marine explorer and navigator, and one who is now universally acclaimed as the founder of the science of oceanography. On the same date, nearly one hundred years later, was made one of the most fruitful hauls of the *Challenger* Expedition, the results of the world-wide collections of which form the main basis upon which modern oceanography is built, and have dispelled for all time the belief that the deepest parts of the ocean are uninhabitable.

H.M.S. *Challenger*. February 14, 1876. Lat. 37° 17′ S.: long. 53° 52′ W. Station 320 (Sounding 407). Falkland Islands to Rio de la Plata.

"At 11.30 a.m. commenced heaving in trawl, which came up at 12.30 p.m., containing a little mud, five or six phosphatic concretions, and numerous specimens. This was one of the richest hauls made during the cruise."

"Excluding Protozoa, nearly 500 specimens of invertebrates and fishes were obtained at this Station, belonging to about 127 species, of which 103 are new to science, including representatives of 19 new genera; 80 of the new species and 6 new genera were not obtained elsewhere."

Societies and Academies

London

Royal Society, Feb. 2. J. C. McLennan and R. Turnbull: The ultra-violet absorption bands of xenon. The characteristic features of the two absorption bands in the neighbourhood of the resonance lines λ 1469·6 A. and λ 1295·6 A. can be explained by supposing them to be due primarily to absorption occurring during atomic collisions, when the energy levels of the colliding atoms were perturbed by their mutual interactions. At the lower pressures, mainly two-body collisions are effective, but at pressures above 90 mm. of mercury and at room temperature, collisions between three or more atoms occur frequently enough to affect appreciably the absorption. A comparison of the absorption bands at λ 1469·6 A. and λ 1295·6 A. reveals that with xenon, two-atom aggregates involving one atom in the $1\ P_1{}^0$ state are less stable than two-atom aggregates having one of the constituent atoms in the $3\ P_1{}^0$ state. D. M. Newitt and A. M. Bloch: The slow combustion of ethane at high pressures. In the slow combustion of ethane-oxygen mixtures of composition 85–90 ethane with 15–10 per cent oxygen, at high pressures, intermediate products, representing the six possible 'hydroxylation' steps whereby the ethane molecule is oxidised, have been isolated. At 100 atmospheres pressure, upwards of 60 (and in one case more than 70) per cent of the carbon of the ethane burnt survived as condensable and water-soluble intermediate products. Ethyl alcohol and/or acetic acid predominated among the surviving intermediate products but, in addition, considerable quantities of methyl alcohol, acetaldehyde and steam were always present together with smaller amounts of formaldehyde and formic acid. The effect of increasing the initial pressure of the reacting medium was in general to favour the survival of ethyl alcohol, acetaldehyde and acetic acid (that is, of products formed without any rupture of the ethane molecule).

Geological Society, Dec. 21. L. Hawkes and Hilda K. Hawkes: The Sandfell laccolith and 'Dome of Elevation'. Sandfell—a hill of rhyolitic oligoclase porphyry intruded into the plateau basalt series on the south side of Faskrudsfjord, eastern Iceland—is a laccolith which in form, relationship to the country rocks, and exposure, is comparable with the type intrusions of the Henry Mountains. The thickness of the original cover can be determined with greater precision than has hitherto been possible for such bodies, and it can be demonstrated that intrusion was accompanied by a doming at the earth's surface. The northern junction is mainly a faulted one, and the laccolith is asymmetric. S. Smith (with notes on fossils by C. J. Stubblefield): The occurrence of Tremadoc shales in the Tortworth Inlier, Gloucestershire. Hitherto the Tortworth Inlier has been considered as entirely of Silurian age, but recently Tremadoc fossils were found by one of the authors in the soft bluish-grey shale which forms much of the northern part of the Palæozoic outcrop. The Tremadoc rocks, for which the name 'Breadstone shales' is proposed, occupy the entire width of the inlier between Purton and Mobley and *cover an area of approximately* 3½ square miles. They provide the most southerly exposure of Cambrian rocks in Britain. Their outcrop lies nearly 30 miles south of that of the Bronsil shales of the Malvern region. A. D. N. Bain: The younger intrusive rocks of the Kudaru Hills, Nigeria. The members of the series present in these hills consist of a mass of cone-sheets and dykes surrounding pyroxene-fayalite-, riebeckite-, and biotite-granites, the riebeckite-granite forming the main intrusion. The earliest member is a very large cone-sheet consisting of a unique rock type, a pyroxene-fayalite-quartz-porphyry. The field work definitely establishes two swarms of minor intrusions, one coming before the main granites and the other and more numerous swarm, after them. The whole group has the form of an inverted cedar-tree laccolith or chonolith.

PARIS

Academy of Sciences, Dec. 27 (195, 1337–1440). Jules Drach : The integration by quadrature of a class of differential equations : $d^2y/dx^2 = F(x, y)$. A. Cotton and M. Schérer : The magnetic rotatory dispersion of a coloured diamagnetic compound, thiobenzophenone. These determinations were carried out with the liquid film only 0·13 mm. thick. For this diamagnetic liquid the anomalies of the magnetic rotatory dispersion were quite clear on both sides of the absorption band, but do not show the same characters previously noted in the case of cobalt chloride. The work will be continued with higher magnetic fields. C. Matignon and M. Séon : The action of steam on methane. Studies of the effects of different catalysts on the course of the reaction $CH_4 + 2H_2O = CO_2 + 4H_2$. Zirconia proved to be the best catalyst. Gabriel Bertrand and L. Silberstein : The importance of sulphates as manure. Laboratory experiments show that the introduction of a certain proportion of combined sulphur in an assimilable form is necessary. The use of potassium and ammonium sulphates in the field is suggested as desirable. Jean Cabannes : The Raman spectrum of the SO_4 ion in gypsum. A. Bigot : The rôle of solifluxion in the morphogeny of the hills of Normandy and the Maine. Paul Vincensini : The focal points of circles of a congruence. Georges Giraud : Non-linear equations of the elliptic type. General theorem and application. Soula : Integral equations of the first species with fixed limits. Juljusz Schauder : Partial' differential equations of the elliptic type. Herman Auerbach : Limited groups of linear substitutions. Carl A. Garabedian : The thick rectangular plate, uniformly loaded, the two opposite edges of which at least are supported. Maurice Golaz : Remarks on the viscosity of water. Jean Louis Destouches : Remarks on the theory of superquantification. Max Serruys : The localisation of the phenomena of detonation. Experimental study of knocking in an internal combustion motor. Antonio Cabreira : The variation of the orbit and velocity of Halley's comet and its distance from the planets causing the perturbations. Th. De Donder : The linearisation of any (ds^2). A. Hautot : The structure of the $K\alpha$ line of carbon. G. A. Boutry : The design of a low-frequency amplifier for the photoelectric cell. P. Fourmarier : The action of a magnetic field on a gas-filled photoelectric cell. F. Gallais : Silver iodomercurate. From measurements of the coefficient of magnetisation the existence of the complex compound Ag_2HgI_4 is proved, agreeing with the conclusions of J. Ketelaar based on X-ray diagrams. L. Palfray, S. Sabetay and Mlle. Denise Sontag : The action of various dehydrating agents on primary phenylethyl alcohol. When dehydration takes place, styrolene is formed in preference to the ether oxide. Paul Fleury and Jacques Lange : The oxidation of the acid alcohols and the sugars by periodic acid. This reaction appears to be specific for the α-diols. L. and H. Longchambon : The vanadinite from Hérival (Vosges). Mlle. Henriette Alimen : The palæontological bases of a subdivision of the Stampian in the Paris basin. G. Delépine : The extension of the Palæozoic seas in Asturia (Spain). Mlle. S. Gillet : An attempt at the classification of the upper Miocene and the lower Pliocene in Roumania. Transylvania and the Banat. D. Schneegans : The subdivisions of the Ubaye sheet in the Morgon massif (French Alps). F. M. Bergounioux : The place of the Trionyx in the classification of the chelonians. J. Coulomb : Researches on the magnetic anomaly at the summit of the Puy de Dôme. Idrac : Researches on the submarine phenomena of the bay of Villefranche-sur-Mer. Pierre Frémy : Living Cyanophyceæ in the thallus of *Codium*. A. Vladesco : The first partitions of the zygote in the leptosporangiate ferns. Mlle. Dzung Tsin Wang : Some observations on *Ustilago violacea*. E. Michel-Durand : The nitrogen, sulphur, phosphorus and potassium of the leaves of *Prunus laurocerasus* at the moment of their fall. E. Fischer-Piette, Roger Heim and Robert Lami : Preliminary note on a bacterial disease of *Zostera*. Léon Bertin : The anatomical bases of the classification of the apodal fishes belonging to the sub-order of the Lyomers. Emile F. Terroine and Mlle. Gilberte Mourot : The formation of puric compounds at the expense of protein material in endogenous nitrogen metabolism. Fernand Mercier and J. Balansard : Chemical and pharmacodynamical researches on the cardiotoxic principles of *Cryptostegia madagascariensis*. H. Labbé and M. Rubinstein : The action of adrenaline on the nitrogen exchanges. James Basset and M. A. Machebœuf : The study of the biological effects of ultra-pressures. Resistance of bacteria, diastases and toxins to very high pressures. M. and Mme. G. S. Adair and M. and Mme. J. Roche : Researches on the molecular weight of globin from various hæmoglobins. Ch. Dhéré : The tegumentary porphyrin of *Lumbricus terrestris*. S. Turchini : Remarkable effects of diathermo-coagulation in cancers of radiobiologists attacked by radiodermatitis.

GENEVA

Society of Physics and Natural History, Dec. 1. G. Tiercy : The variation of ionisation and the spectrum variation of some Cepheids. The extreme spectra correspond to the extremes of ionisation and the maximum ionisation is a little ahead of the light maximum, whilst the minimum of ionisation is ahead of the light minimum. E. Cherbuliez and Fr. Meyer : New researches on casein. Following up their earlier work, the authors conclude that casein from cow's milk is a mixture of at least four constituents which have been isolated, and the proportion of which in casein is not constant. R. Wavre : New examples of polydromes of prolonged Newtonian potentials. H. Lagotala : (1) Borings in the marly limestones of Renéville (French Congo). A description of the formations met with in the course of five borings, one of which gave the composition of the strata over 95 metres. The marly limestones found at the levels of schists (micaceous, grits, etc.) belong to the formation of the Niari limestones (schist-limestone series of Delhaye and Sluys). (2) Concerning the stratigraphic scale of the Niari limestones. It is impossible to utilise the divisions accepted by Delhaye and Sluys, and later by Babet, for the subdivision of the Niari limestones. In fact, the layers which should serve as a basis of reference are not constant in their facies. The author confines himself to establishing two groups, the lower ending with the appearance of the oolitic facies, following on a marl or clay facies. P. Balavoine : Contribution to the tetrafluoride test. By the action of water on silicon fluoride, there is not only formation of silica, since, carried out in contact with glass, the reaction also causes corrosion of the glass. C. Dallwick : Presentation of a map produced by the projection of the sphere on the icosahedron.

Forthcoming Events

Saturday, Feb. 11

SCHOOL NATURE STUDY UNION, at 2.30—(at Botanical Theatre, University College, Gower Street, W.C.). Annual Conference. At 3—Sir Frank Dyson: "Astronomy—Old and New".

Monday, Feb. 13

ROYAL GEOGRAPHICAL SOCIETY, at 5.—A. C. O'Dell: "The Urbanisation of the Shetland Islands".

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. H. R. Ing: "Chemical Structure and Pharmacological Action" (succeeding lectures on Feb. 20, 27, March 6, 13 and 20).

UNIVERSITY OF LEEDS, at 5.15.—Prof. J. Barcroft: "The Evolution of the Body as a Milieu Adequate for the Mind".

INSTITUTION OF ELECTRICAL ENGINEERS (MERSEY AND NORTH WALES CENTRE), at 7.30—(Faraday Lecture at the Central Hall, Renshaw Street, Liverpool).—Prof. J. T. MacGregor-Morris: "Lightning, and how the Engineer deals with its Effects" (to be repeated before other Sections).

Tuesday, Feb. 14

ROYAL INSTITUTION, at 5.15.—Sir William Bragg: "The Analysis of Crystal Structure by X-Rays: A Review of the Work of Twenty Years" (succeeding lectures on Feb. 21, 28 and March 7).

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Prof. J. A. Gunn: "The Search for New Remedies".

Wednesday, Feb. 15

ROYAL METEOROLOGICAL SOCIETY, at 5.15—(Presidential Address).—Prof. S. Chapman: "Atoms, Molecules and Atmosphere".

UNIVERSITY COLLEGE, LONDON, at 5.30.—I. C. Gröndahl: "Oslo and its Environs" (succeeding lectures on Feb. 22 and March 1).

UNIVERSITY COLLEGE, LONDON, at 5.30.—J. Ross: "The Work of the Bristol Public Library".

ROYAL SOCIETY OF ARTS, at 8.—Capt. Harold K. Salvesen: "Modern Whaling in the Antarctic" (Film).

Thursday, Feb. 16

UNIVERSITY OF LONDON, at 5—(at the London School of Economics).—A. W. Street: "The Marketing of Agricultural Produce" (succeeding lecture on Feb. 23).

LONDON MATHEMATICAL SOCIETY, at 5.—Prof. P. A. M. Dirac: "The Relation between Classical and Quantum Mechanics".

ROYAL INSTITUTION, at 5.15.—A. R. Hinks: "Geography in the Public Service" (succeeding lectures on Feb. 23, March 2 and 9).

CHEMICAL SOCIETY, at 8.—Discussion on "The Raman Effect in Relation to some Chemical Problems", to be opened by Dr. J. J. Fox.

LINNEAN SOCIETY—(Hooker Lecture). Sir William Wright Smith.

Friday, Feb. 17

INSTITUTION OF CHEMICAL ENGINEERS, at 11.—Eleventh Annual Corporate Meeting. At 11.45, The Right Hon. the Viscount Leverhulme: "Chemical Engineering and the Soap Industry".

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—(Annual General Meeting).

INSTITUTION OF MECHANICAL ENGINEERS, at 5.30—(Annual General Meeting).—F. R. B. Watson: "The Production of a Vacuum in an Air Tank by Means of a Steam Jet".

Saturday, Feb. 18

ROYAL INSTITUTION, at 3.—Lord Rutherford: "Detection and Production of Swift Particles".

Official Publications Received

GREAT BRITAIN AND IRELAND

Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on January 17th, 1933. Pp. 8. (London.)

The British Chemical Plant Manufacturers' Association. Official Directory of Members, 1933: with a Classified List of their Manufactures and Services. Pp. 174. (London.) Free.

British Chemicals and their Manufacturers: the Official Directory of the Association of British Chemical Manufacturers (Incorporated). Pp. 430. (London.) Free.

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 32: An Investigation of the Behaviour of Neon Discharge Tubes in a Flashing Capacity Circuit by means of a Cathode Ray Oscillograph. By Dr. J. H. J. Poole. Pp. 477–486+plate 44. 1*s*. Vol. 20 (N.S.), No. 33: Bast-Sap. By Prof. Henry H. Dixon. Pp. 487–494+plate 45. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Journal of the Society for the Preservation of the Fauna of the Empire. New Series, Part 18, January. Pp. 61. (Hertford: Stephen Austin and Sons, Ltd.) 2*s*.

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics, No. 4: The Inheritance of Anthocyanin Pigmentation in Asiatic Cottons. By J. B. Hutchinson. Pp. 317–339+plates 25–26. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*.

Scottish Marine Biological Association. Annual Report, 1931–32. Pp. 24. (Glasgow.)

Proceedings of the Royal Society of Edinburgh, Session 1932–1933. Vol. 53, Part 1, No. 1: On the Development of the Olfactory Organ in *Protopterus*. By Margaret H. Fullarton. Pp. 6. 9*d*. Vol. 53, Part 1, No. 2: A Matrix Notation for Mendelian Populations. By Prof. Lancelot Hogben. Pp. 7–25. 1*s*. 6*d*. Vol. 53, Part 1, No. 3: Supernumerary Pectoral Fins in *Raia circularis* Loudon. By Dr. W. F. Harper. Pp. 26–30. 9*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 2, No. 18: A Study of the Foliar Endodermis in the Plantaginaceæ. By George Trapp. Pp. 523–546. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 3*s*.

OTHER COUNTRIES

Proceedings of the Imperial Academy. Vol. 8, No. 9, November. Pp. xxv–xxvii+407–473. (Tokyo.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 33, Part 2: H. Sauter's Formosa-Ausbeute—Ichneumonidæ (Hym.). By Toichi Uchida. Pp. 133–222. (Tokyo: Maruzen Co., Ltd.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 89: Measurements of the Solid Viscosities of Metals through the Flexural Vibrations of a Bar. By Katsutada Sezawa and Kei Kubo. Pp. 195–231. (Tôkyô: Koseikai Publishing House.) 45 sen.

The Journal of Chemical Physics. Vol. 1, No. 1, January. Pp. 128. Lancaster, Pa., and New York: American Institute of Physics.) 1.25 dollars.

Bulletin of the American Museum of Natural History. Vol. 63, Art. 5: Herpetological Results of the Whitney South Sea Expedition, 6: Pacific Island Amphibians and Reptiles in the Collection of the American Museum of Natural History. By Charles E. Burt and May Danheim Burt. Pp. 461–597. Vol. 65: The Birds of the Belgian Congo, Part 1. By James P. Chapin. Pp. x+756+11 plates. (New York City.)

Publications de l'Observatoire Astronomique de l'Université de Belgrade. Tome 5: Annuaire pour l'an 1933. Rédigé par V. V. Michkovitch. Pp. 110. (Beograd.)

Report on the Administration of the Meteorological Department of the Government of India in 1931–32. Pp. ii+34. (Calcutta: Government of India Central Publication Branch.) 8 annas; 10*d*.

Library of Congress. Report of the Librarian of Congress for the Fiscal Year ending June 30th, 1932. Pp. vi+343+11 plates. (Washington, D.C.: Government Printing Office.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions, Vol. 80: The Effect upon the Stock of Fish of the Capture of Undersized Fish; Reports of the Proceedings of a Special Meeting held on June 24th, 1932, at Copenhagen. Pp. iv+88. (Copenhague: Andr. Fred. Høst et fils.) 3.75 kr.

Report of the Department of Industries, Madras, for the Year ending 31st March 1932. Pp. 71. (Madras: Government Press.) 8 annas.

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 21, No. 4, December. Pp. 455–725. (Tokyo and Sendai: Maruzen Co., Ltd.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 15, No. 6, November. Pp. 351–372. (Tokyo and Sendai: Maruzen Co., Ltd.) 90 sen.

Science Reports of the Tokyo Bunrika Daigaku. Section B, No. 4: Notes on some Rare Materials of Japanese Oxyrhyncha. By Tsune Sakai. Pp. 41–59+3 plates. 26 sen. Section B, Nos. 5–10: Studies on Amphibian Chromosomes, 4, On the Chromosomes of *Rana rugosa* and *Rana nigromaculata*, by Shigemori Iriki; Studies on Amphibian Chromosomes, 5, Explanation of the Sex-Chromosomes Type of *Hyla arborea japonica* from the Standpoint of Spiral Structure, by Shigemori Iriki; Studies on Amphibian Chromosomes, 6, On the Chromosomes of *Diemyctylus pyrrhogaster*, by Shigemori Iriki; Studies on Amphibian Chromosomes, 7, On the Chromosomes of *Megalobatrachus japonicus*, by Shigemori Iriki; Studies on Amphibian Chromosomes, 8, On the Fixation of the Chromosomes of *Hyla arborea japonica* and some other Animals, by Shigemori Iriki; Studies on the Chromosomes of Pisces—On the Chromosomes of *Aplocheilus latipes*, by Shigemori Iriki. Pp. 61–131+plates 4–12. (Tokyo: Maruzen Co., Ltd.) 1.05 yen.

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Science in the Schools

THE recent report on the School Certificate examinations conducted in England and Wales* is an illuminating and an alarming document. It reveals the grave fact that an examination originally "designed to test the results of the course of general education before the pupil begins such a degree of specialisation as is suitable for Secondary Schools" has petrified the curricula of the schools in a mould that eliminates almost completely any individual efforts at originality or initiative. The danger was foreseen, for when the scheme was begun, some fourteen years ago, it was laid down as a cardinal principle that "the examination should follow the curriculum and not determine it". What apparently was not foreseen was the impossibility of establishing a general examination with a limited syllabus, yet preventing schools from working almost wholly to that syllabus. It is true that there are eight distinct bodies conducting School Certificate examinations, but the greatest pains have been taken to make all eight examinations as like as so many peas, until now no one could distinguish between them by a mere inspection of the questions.

In the summer of 1931, 66,909 candidates sat for the School Certificate examination. Assuming four years as the average time of preparation, it follows that the educational course of a quarter of a million boys and girls in England and Wales is being directly moulded by the requirements of eight slight variants of the same syllabus. The candidates are by no means drawn from the State-aided schools alone ; on the contrary, the public schools present a contingent that forms perhaps 25 per cent of the total entry. The question whether this application of mass-production to education is not likely to have extremely pernicious results is consequently a very pertinent one, demanding the immediate and careful attention of everyone who has the interests of the children of the country —and therefore the future of the country itself— at heart.

Examinations are not necessarily an evil. They serve purposes that could not be adequately fulfilled by any other means, and a body of competent examiners can form a very accurate, and thus very useful, estimate of a candidate's attainments and ability. It is, however, clearly undesirable that the educational system of the country should be so ridden by a stereotyped examination that, to all intents and purposes, every boy and girl at sixteen has learned exactly the same things, taught in exactly the same way. It is particularly deplorable that the public schools, where experiments in education are most easily possible, and where, in the past, great educational reforms have in fact been initiated, should have fallen so completely under the spell of the School Certificate.

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* The School Certificate Examination : being the Report of the Panel of Investigators appointed by the Secondary School Examinations Council to inquire into the Eight Approved School Certificate Examinations held in the Summer of 1931. (London : H.M. Stationery Office, 1932.) 2*s*. 6*d*. net.

Admittedly their position is difficult. The possession of a School Certificate is of great value to many boys (especially since it may be, what it certainly ought not to be, a matriculation qualification), and of vital importance to some; so that if parents require public schools to prepare their sons for this examination, the schools must either acquiesce or lose the fees. The latter, under present conditions, they can ill afford to do, and so the fetters become more and more firmly riveted. It is a depressing thought that the great schools of England should be judged, in any degree, upon the lengths of their respective lists of successful candidates at the School Certificate; but there is growing evidence that judgment is frequently passed upon these very grounds. Freedom to follow new ideas is essential to the health of education, and if the public schools are to remain hampered by the rigid demands of the School Certificate syllabus, our best educational laboratories will become stultified and unfruitful.

For the moment, however, we must face the unhappy fact that the School Certificate is the predominating influence in secondary education. Until that influence can be reduced to the useful minimum originally anticipated, it behoves the country to ensure that the examination is brought to the highest degree of efficiency, the broadest degree of sanity, and the lowest degree of pedantry in syllabus, that can be achieved; though there are many who doubt whether an external examination of any kind, however excellent, is desirable at the early age of sixteen. The present report, drawn up by a panel of investigators composed of several of H.M. inspectors of schools and representative head-masters, head-mistresses and other teachers, while disturbingly complacent over the problem as a whole, offers many suggestions for improvement in detail and is reassuring upon the efficiency of the examining bodies. Upon the last point, indeed, no one has any serious doubt. The machinery is well designed and runs smoothly; examiners are chosen with care and are properly coached in their duties; cases of injustice to candidates are so rare as to be practically non-existent; and the schools are taken into free and constant consultation. There are, inevitably, technical details that require adjustment, and the panel has many observations to make on such matters, but the general impression left by the report is that the administrative and examining sides of the system—one had almost written the industry—leave little to be desired.

The real difficulties become apparent only when we pass from the machinery to the syllabuses. Though there is a good deal that might be said upon the other subjects of the examination, in these columns we shall deal solely with the problem of science—partly because it is our proper sphere, but chiefly because the place of science in education is still so largely a matter of controversy that School Certificate science needs very close consideration. The cardinal fact, always to be borne in mind, is that the School Certificate syllabus represents the whole of the training in science that the vast majority of middle and upper class citizens are likely to receive. We must inquire whether the work is oriented towards satisfactory objectives and whether it is pursued by adequate methods. The country is fortunate in possessing two such enthusiastic and able bodies of teachers as the Science Masters' Association and the Association of Women Science Teachers, but the grip of the School Certificate is so firmly set upon the schools that every public and secondary school master or mistress must work within narrow and well-defined limits. Consequently, though the methods of science teaching may be sound, the position cannot be regarded as satisfactory unless the examination limits are wide enough to admit the full objectives, and unless the objectives themselves are adequately conceived.

We confess that, in our opinion, the proper aims of school science do not appear to have been fully realised either by the panel of investigators or by the examining bodies. The importance of science to a good citizen, *qua* citizen, is duly emphasised, as in a modern system of State education it could scarcely fail to be. The value of scientific knowledge to a man or woman, as an aid to health and as a factor in earning a livelihood, is also not forgotten. But of the joy of science for its own sake, the intellectual joy that gives pleasure of a permanent and unequalled quality, the School Certificate (O shade of Aristotle!) has apparently never conceived. Also, except in so far as it is one among many essential social activities, the future of science is completely ignored. It has not yet occurred to our educational arbiters that, if the world is to continue to exist, the well-being and progress of science must be assured. We should like to have seen a bold gesture on the part of the investigators, either completely remoulding the present syllabuses in science, or insisting upon a radically different method of examining upon them. Intrinsically, perhaps, the syllabuses are moderately satisfactory, and in some branches even good; but the questions set—which determine the teaching—are far too academic. History shows us unmistakably that scientific philosophy is late in flowering; and if we may take the maxim as roughly true that the intellectual development of the child recapitulates that of the race, we shall see the folly of asking a normal boy or girl of sixteen to deduce Gay-Lussac's law from Avogadro's hypothesis, or to answer similar questions on recondite theory. If an external, uniform examination is to be inflicted upon young children, then, so far as science is concerned, the work should be much more largely observational and descriptive, a wider choice of subjects should be allowed, and the questions should be far less technical.

The panel takes a step in this direction—a step that we welcome—by recommending the establishment of an obligatory paper on elementary science, covering an extensive field, followed by additional papers on physics, chemistry and biology which would be optional. The basic idea of this scheme is admirable, and, with reservations, we hope that it may be adopted. It would result in a broader appreciation of science, and would attract many children who are frankly bored or dazed by the more purely academic courses at present offered them. But it is easy to foresee certain difficulties that will have to be overcome if the step in advance is not to metamorphose into a retrograde movement. The most serious of them is to prevent the danger that a course in elementary science may develop into a shallow smattering of more or less disconnected topics, in which all the peculiar value and character of science is lost. A second difficulty lies in finding teachers properly equipped for a scheme of this kind, for it seems clear that the course could not fully attain its purpose if different parts of it were taught by different men; while unfortunately many science teachers are not well informed in branches of science other than their own. A third difficulty, which is, however, a matter for the administration, will arise from the fact that Higher Certificate science will need to be reorganised if a School Certificate candidate can obtain a pass in science on the proposed elementary paper.

A final point of importance in the recommendations in the report is the suggestion that practical examinations be dropped at the School Certificate stage. Some of the examining bodies have already taken this course, and the panel of investigators thinks that the others might well follow their example. If the authorities are satisfied that the practical work in schools will not suffer by the absence of a practical examination, we have no adverse comment to make; but we may perhaps remind them of the long and strenuous fight that had to be made to put school practical science on a sound footing, and we trust that they are not proposing to throw away a valuable asset.

Evolution of the Microscope

The History of the Microscope: Compiled from Original Instruments and Documents, up to the Introduction of the Achromatic Microscope. By Dr. Reginald S. Clay and Thomas H. Court. Pp. xiv+266. (London: Charles Griffin and Co., Ltd., 1932.) 30*s*. net.

THE story of the development of any scientific instrument is an interesting one, but this is especially so when the result of the development is so universally known and used as the microscope.

It is impossible to imagine the modern scientific laboratory without this invaluable tool. The pathologist, to whom the clinician refers for help in a diagnosis, the bacteriologist, studying the purity of our foods, and the physicist, making measurements of fundamental importance, all depend on the efficiency of a system of lenses grouped together to magnify the object which is being observed. The microscope has become such a commonplace that we are apt to forget its importance, and its origin.

The book under review has been prepared by two men particularly well equipped to write an authoritative treatise on the history of the microscope. Both of them are known as collectors of old optical instruments. Mr. T. H. Court, the generous donor of a unique collection of scientific instruments to the Science Museum, South Kensington, has for many years collected not only instruments but also books, catalogues, and trade-cards which have thrown great light on many obscure points in connexion with the manufacture and sale of the microscope. Dr. R. S. Clay, possessing not only a valuable collection of microscopes but also of optical literature, has brought to his task a knowledge of optics which is authoritative.

The microscope is not old as compared with the astrolabe or some of the instruments devised for determining the position of the heavenly bodies. The single lens, however, is undoubtedly the oldest optical instrument, and from combinations of such lenses the telescope and the microscope were evolved.

The authors have examined many early references, and show that the credit for the invention both of the telescope and microscope must be given to the Dutch spectacle-makers, Hans Jansen and his son Zacharias. The first instruments were made about 1590, or at the beginning of the seventeenth century, the period which saw the birth of physical science as we understand it. The knowledge of the possibilities of the microscope soon spread, and we learn that Cornelius Drebbel (the mathematical tutor to James I) was making microscopes from 1619 to 1623, although they were probably single-lens instruments. The Drebbel instruments became well known, and the value of the instrument for scientific research may be said to date from this time.

In 1665 Robert Hooke published the "Micrographia"—a book which fills one with wonder at the originality and variety of the ideas contained in it. It includes many copper-plate illustrations of objects which Hooke had drawn in great detail with the aid of the microscope, such as the edge of a razor, the point of a needle, sections of plants, moulds and insects. Hooke described in some detail the construction of his microscope. The objective consisted of a double-convex lens of short focal length, mounted in a cell with a pin-hole diaphragm close to the lens; the eye-piece consisted of a large field-glass and an eye lens. For some time it was thought that Hooke had suggested the use of the field lens, but there is little doubt that this was due to Monconys, who in his "Voyages", published in 1665, gave a specification of a microscope he had had constructed by Campani in 1660, which included a field lens. There is no doubt that microscopes fitted with field lenses were being sold in London in 1662. Helvelius, who had a great admiration for the English microscope, added in 1673 to an English-made instrument, the focusing screw, and a fine adjustment for focusing the object—a great advance on the cumbersome method of sliding the vellum tubes one inside the other.

Marshall may be regarded as the first great English optician. His microscopes were well constructed and in great demand. He revived, if he did not re-invent, the slow-motion focusing adjustment of Helvelius, and fitted a ball and socket joint at the bottom of the pillar so that this instrument could be inclined at a convenient angle for observation. He was the first to fit a condensing lens under the stage of the microscope for the better illumination of transparent objects. A set of six objectives of varying magnifying powers were generally supplied in a drawer fitted in the base of the instrument.

The circulation of the blood had been discovered by Harvey in 1628, and thus its demonstration in the tail of a fish or in the web of a frog's foot was of great interest to users of microscopes. Marshall actually advertised his instrument as the "New Invented Double Microscope for Viewing the Circulation of the Blood". The possibility of being able to demonstrate the circulation of the blood with a microscope remained for more than a century one of the greatest selling points of the instrument. Accessories for holding the frog or fish were included in the majority of microscope outfits.

The next great step in the development of the microscope was due to Hertel. In a book published in 1716, he described in detail an instrument which contained some important features, the chief of which was a plane mirror for illuminating transparent objects; he also invented a screw, and a ruled micrometer—three inventions of such importance that his name should be remembered with gratitude. About fourteen years later, Culpeper introduced the concave mirror mounted on gimbals and placed in the optic axis of the instrument. This, as the authors point out, was one of the greatest inventions made in connexion with the microscope, combining as it does the functions of the reflector and condenser. The placing of the mirror permanently in the optic axis had a great influence in perpetuating the rigid upright axis. In 1744, Cuff made the vertical type of microscope completely in brass, and reverted to the Helvelius method of focusing which had been so strangely neglected for seventy years.

Benjamin Martin, 1704–82, had a great influence on the development and use of the microscope.

He published a large series of popular handbooks on physics, and particularly on optical instruments. Judging by the number of these books that are to be found in the catalogues of second-hand booksellers, they must have had a large circulation. He was responsible for the design of the 'drum' microscope which became so popular, being made in large numbers on the Continent. The two George Adams, father and son, made microscopes of outstanding quality, and they vied with Martin in making advances in the design and construction of their instruments. In addition to their mechanical abilities, they both had marked literary gifts which were shown in a series of textbooks. The father published the first edition of his "Micrographia Illustrata" in 1746, and the son entirely re-wrote the work in his "Essays on the Microscope" published in 1787. In his 'Prince of Wales' microscope, Adams, Sr., mounted the instrument on trunnions, and fitted a rack and pinion coarse-adjustment, and a screw fine-adjustment. For convenience in working, and for rigidity, this instrument was far ahead of its competitors. It is not easy to understand why the trunnion form of mounting was not adopted. It had to wait for nearly fifty years before it was re-introduced; it is now used universally in all first-class instruments.

Space has not allowed of any discussion on the simple microscope. This is not for want of material in the book, because the authors have given us in Chap. iii (45 pages) an interesting story of Leeuwenhoek's instruments, and the development of the simple instrument. Chap. x, dealing with solar and scroll instruments, brings home vividly to the reader the disadvantages of sunlight as a source of illumination as compared with the modern electric lamp.

A list of instrument makers, with brief biographical notes, contains information which must have taken a great deal of patient research to obtain. This research is an outstanding feature of the book.

A few errors and omissions have been noted, and should be corrected in a second edition. Page 118—the name Baker is incorrect, it should be Barker (see p. 229): Page 156—the date of the invention of the micrometer by Gascoigne was 1638 not 1743: Page 183—for Milsdoerffer, Mitsdorffer should be read: Page 199—the title of the book by Adams, Jr., was "Essays on the Microscope" and not "Micrographical Essays": the name of John Cuff should be inserted in the list of instrument makers.

It is not easy to clothe the dead bones of the history of an instrument and to make them tell a living story. This the authors have succeeded in doing in a way which evokes admiration. Unfortunately they finish the story of the microscope before the introduction of the achromatic lens. It is to be hoped that some day, in a succeeding volume, they will be able to bring the narrative up to modern times.

ROBERT S. WHIPPLE.

A Concise Theoretical Physics

Lehrbuch der theoretischen Physik. Von Prof. Dr. Georg Joos. Pp. xvi+644. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932.) 26 gold marks.

THE author has set himself the considerable task of covering in six hundred pages the whole of theoretical physics, including modern developments, and it may be said at once that he has been extraordinarily successful in conveying, in the brief space at his disposal, the essence of the theories which he exposes. While the book is necessarily mathematical, no calculation of any importance is ever carried out without introductory discussion in which the assumptions and their meaning are carefully set forth. It is, in fact, just such a treatment as the practical physicist requires, and the exemplary self-control, such as is not always exercised by his countrymen, with which the author has confined himself to essentials, has not only enabled him to pack his matter into one volume but has also given that volume a very attractive unity.

The first third of the book is taken up by a mathematical introduction, quite simply written, in which the author expounds the vector calculus and certain matters not usually dealt with in ordinary courses of elementary mathematics, and by a section on mechanics, covering elementary elasticity and hydrodynamics and leading up to relativity. The next section, which can be roughly described as dealing with classical electricity, includes, as a development of electromagnetic waves, all that the book has to say of light. It is followed by a treatment of the atomic aspect of electricity, in which the author starts with the conduction through liquids, and then proceeds to gases and finally metals. He takes dielectrics and magnetism together, a good example of the method in which he has frequently abandoned traditional arrangement in favour of, from the mathematical point of view, a more logical grouping. The theory of heat he treats first from the thermodynamic, then from the statistical point of view, the latter leading up to radiation and the new statistics of Fermi and Bose. His last section, on the structure of the atom, closes with a brief treatment of wave mechanics.

The author very justly says in his preface that the book is not a mountain railway, to bring the reader without effort to the peaks, but rather a mountain guide, which leads the reader to places from which he can get a good view of the peaks. It will not make easy reading for a student approaching the subject for the first time, but it is a most excellent book for him to study with a teacher, or for him to use in order to complete and consolidate preliminary knowledge. For the more experienced student and for the teacher of physics rather than of applied mathematics, it is in every way to be commended. E. N. da C. A.

Descriptive Zoology

Handbuch der Zoologie: eine Naturgeschichte der Stämme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach.

(1) Bd. 2: Vermes Amera, Vermes Polymera, Echiurida, Sipunculida, Priapulida. Lief. 11. Pp. 257–416. 18 gold marks.
(2) Bd. 2, Lief. 12. Pp. 32 + 64. 12 gold marks; Lief. 13. Pp. 65–212. 18 gold marks.
(3) Bd. 2, Lief. 14. Pp. 160. 20 gold marks.
(4) Bd. 3, Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lief. 1, Teil 3. Pp. 160. 20 gold marks; Lief. 2. Pp. 32 + 48. 10 gold marks; Lief. 3. Pp. 32 + 64. 12 gold marks.
(5) Bd. 6: Acrania (Cephalopoda), Cyclostoma, Ichthya, Amphibia. Hälfte 2, Lief. 1. Pp. 112. 15 gold marks; Lief. 2. Pp. 113–208. 12 gold marks.
(6) Bd. 7: Sauropsida, Allgemeines; Reptilia; Aves. Hälfte 1, Lief. 1. Pp. 128. 16 gold marks.
(7) Bd. 7: Sauropsida, Allgemeines; Reptilia; Aves. Hälfte 2, Lief. 6. Pp. 545–656. 14 gold marks.
(Berlin und Leipzig: Walter de Gruyter und Co., 1930–1932.)

VOL. 1 of this work, which is to consist of seven volumes, was completed nearly seven years ago and the first half of Vol. 3 in 1927 and of Vol. 4 in 1930. Most of the other volumes are making good progress except the fifth volume (Mollusca, Echinoderma and Tunicata) three parts of which, completing the account of the Mollusca, appeared during 1925 and 1926. About 6,500 pages of the work have now been issued. The editor and publishers are to be congratulated on the output of more than 1,100 pages during 1931, and on maintaining the high standard of authorship and production referred to in our previous notices.

(1) In this part Prof. Fuhrmann completes his account of the Cestoda, characterised by concise and skilful treatment and by its excellent illustrations, seventy of which in the present part are original. The author does not favour the view that the pseudophyllid Cestoda, for example, *Caryophyllæus*, are nearly related to the Trematoda; he regards as much more probable that the Trematoda and Cestoda are quite separate and have been derived from nearly related Turbellaria, for example, the Rhabdocœla, and that resemblances between the Pseudophyllidea and the Trematoda are due to convergence.

(2) A short general introduction to the Annelida by Dr. Riesiger leads to Prof. Hempelmann's account of the structure, reproduction and biology of the Archiannelida and the Polychæta. While this is for the most part altogether adequate, a fuller account of the histology of the nervous system would have been welcome and would have afforded the opportunity for a useful summary of the extensive work on the neurones and their fundamental inter-relationships in Polychæta and other Annelida.

(3) In Prof. Baltzer's hands the Priapulida (14 pp.), Sipunculida (47 pp.) and Echiurida (100 pp., unfinished) receive thorough treatment. The author inclines to the relationship of the Priapulida to the Kinorhyncha, and holds that the Sipunculida and Echiurida are separate and that the old group of Gephyrea must be definitely abandoned. New details are given on the structure of the uterus of *Bonellia*. This uterus is divided into two parts—one for the eggs and the other harbouring the dwarf males—separated by a narrow canal closed by a plug of mucous which is dissolved at the time of egg-laying when the eggs pass into the second chamber and are there fertilised on their way to the exterior. Dr. Baltzer provides a useful summary of the observations and experiments on the determination of sex in the post-larval development of *Bonellia* and on the production of various grades of intersexes. He directs attention, in his

account of the trochosphere of *Echiurus*, to the mesoderm which, as he showed in 1917, does not develop from teloblasts and does not become segmented ; in both these points he corrects the well-known account by Hatschek which is repeated in most textbooks. From the list of parasites of the Echiurida is omitted *Oligognathus bonelliæ*, parasitic in the cœlomic cavity of *Bonellia.*

(4) Lief. 1 contains Dr. Herman Graf Vitzthum's account of the Acari, in which a fair share of attention is devoted to the internal anatomy and to the section on ecology. While the Acari are probably monophyletic, the author points out that the common stem must have divided, possibly in early Devonian times, for the mite *Protacarus crani* from the Old Red Sandstone, Aberdeenshire, described by Hirst, already shows some differentiation towards the recent Eupodidæ. At present there are six main branches forming the recognised sub-orders. The number of genera of Acari approaches 1,000 and of the species about 6,000.

Lief. 2 consists of accounts of Rhabdopleura by Drs. B. Bergersen and Hj. Broch and of *Balanoglossus* by Prof. van der Horst, both well done and fully illustrated. In the first part the authors examine the view put forward by Schepotieff that the Graptolites were Pterobranchia, which they conclude is untenable.

The account of the Merostomata (32 pp. unfinished) by Prof. U. Gerhardt and of the Pycnogonida (64 pp.) by Dr. H. Helfer constitute the third section. In the latter, the development, larval stages, ecology and phylogeny are the most interesting sections.

(5) These two parts form the first portion of the account of the Amphibia by Dr. Franz Werner. A brief survey of the main facts of structure, development, distribution and biology of the class precedes the detailed consideration of the osteological features and the classification of the Stegocephali and the excellent account, with many good figures, of the Apoda (Gymnophiona).

(6) This contains the first instalment of Dr. O. V. Wettstein's description of Sphenodon—the skeleton and teeth (42 pp.), musculature (53 pp.), and nervous system (unfinished 23 pp.), all of which are described in considerable detail and are well illustrated. The labelled drawings of the posterior, ventral, dorsal and lateral aspects of the skull will be helpful to advanced students for such drawings are not readily accessible elsewhere, and a word of commendation is due also for the account of the epiphysis and the pineal eye.

(7) Dr. Stresemann continues his admirable account of the birds and discusses in particular the various movements of the wings and the different types of flight in relation to the anatomy of the bones and muscles and to the feather-planes. Due attention is given to the swimming and diving of birds and the movements in relation thereto of wings, feet and tail. An interesting description follows of the structures concerned in the production of voice and song, in the alteration of tone and in resonance. In the section on geographical distribution are found data on the rate of spread of species and on discontinuous distribution as a result of the past history of the earth.

Short Reviews

Grundzüge der regionalen Limnologie. Von Prof. Dr. Einar Naumann. (Die Binnengewässer: Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten, herausgegeben von Prof. Dr. August Thienemann, Band 11.) Pp. xiv+176+8 Tafeln. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1932.) 20.50 gold marks.

DR. EINAR NAUMANN, professor of limnology at the University of Lund and director of the Limnological Laboratory at Aneboda, Sweden, gives us an instructive discussion on modern principles of research relating to the study of fresh-water lakes. Among his many works on limnology he has already contributed two volumes to "Die Binnengewässer" on the foundations of experimental plankton investigation and an introduction to the study of lake bottoms. Closely related to these is the present work on regional limnology, which embraces a large number of side issues concerned with the detailed investigation of fresh water lakes, their origin, form and contents, both organic and inorganic, involving the co-operation of geologist, physicist, chemist and biologist. This is a very new branch of biological science although a large amount of preliminary work has already been accomplished, especially at Prof. Naumann's own laboratory, which is the headquarters of all such research.

First and foremost in the work are concerned the life in the lakes with the available food and the mapping of the regions and classification with regard to all factors involved—the nature of the bottom, chemical contents, physical features and the plant and animal life present. By such maps one can tell at a glance the kind of lake and its probable inhabitants. The lakes are classified according to the amount and quality of food they can produce and these again are sub-divided. A regular order of these waters is now established so that one can foretell to a large extent what kind of plants and animals inhabit any lake. An enormous amount of work still remains to be done and this is an important addition to the literature of the subject.

Partridge Disease and its Causes, including the Report and Suggestions of the Country Life *Committee of Enquiry into the Diseases of Partridges during the Season 1931–1932.* Edited by Major M. Portal and Dr. Walter E. Collinge. Pp. ix+96+7 plates. (London: *Country Life*, Ltd., 1932.) 12*s*. 6*d*. net.

THE prevalence of a new or hitherto unrecognised disease amongst partridges, which caused heavy mortality during the earlier winter months of 1931, brought about the formation of a *Country Life* committee of inquiry, under the chairmanship of Major M. Portal and with the assistance of Dr. W. E. Collinge as pathologist. While partridges are subject to several fatal diseases, the special features of this epidemic were loss of weight, reluctance of the bird to feed, congestion of the cæca, stomach invariably empty; and the cause was found to be a nematode parasite, *Trichostrongylus tenuis*, harbouring in thousands in the cæca. The life-history of the strongyle has been worked out: it has been found to be spread with the fæces, from which the larvæ swarm up blades of vegetation, with which they are engulfed by other partridges. Although no wild bird seems to be concerned in the distribution of the parasite, earthworms are very frequent carriers of both eggs and larvæ. Any factor which weakens the resistance of partridges predisposes to fatal attack, and amongst such factors the Committee suspects interbreeding, overcrowding in winter, insufficient food, and unfavourable weather conditions. Some of these may be associated, as several replies to a questionnaire issued by the Committee suggest, with modern conditions of farming and roads. Special chapters have been written by experts upon methods of feeding and breeding, so that there has been gathered together in this volume a body of observations and information which no owner of partridge land can afford to ignore.

Rhenium (Opyt monografii elementa No. 75). By E. S. Kronman. Pp. 85. (Moscow and Leningrad: N. K. T. P. The Gold and Platinum Institute, 1932.) 1r. 25k.

MENDELEEFF'S dwi-manganese was discovered in 1925 and the name rhenium assigned to it by W. and I. Noddack has become accepted. Since its discovery, rhenium has been the subject of more than a hundred scientific communications and Dr. Kronman's Russian monograph follows closely upon Mr. P. M. Tyler's "Rhenium (and Masurium)" issued as an information circular by the U.S. Bureau of Mines and Dr. W. Schröter's "Das Rhenium", both of which appeared about two years ago.

This latest work is the most comprehensive, including as it does as complete an account of the geochemistry, isolation, chemistry and physics of the new element as the author has been able to ascertain from the publications accessible to him. He has been somewhat dependent upon abstracts in the *Chemisches Zentrallblatt* for the non-German contributions to the subject (including the letters in NATURE during 1925 *et seq.*). He has, nevertheless, omitted very little of importance and it is therefore regrettable that this monograph, being in Russian, is inaccessible to all but a few chemists and others who are interested in the new element.

J. G. F. DRUCE.

Architectural Graphic Standards: for Architects, Engineers, Decorators, Builders and Draftsmen. By Charles George Ramsey and Harold Reeve Sleeper. Pp. ix+233. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 37*s*. 6*d*. net.

IN recalling the important buildings upon which architects and their assistants worked in bygone years, it does not seem as if the elaborate 'simplicity', claimed for this book, is required. Specifications and details were prepared in those days with an assurance and success, which no mere "graphic and diagrammatic assembly of data, standards and information" would have produced. If this book may be regarded as supplying between two covers a large amount of valuable information for students, it is well, though greater simplicity might be desired. It may be seriously doubted whether any practising architect in Great Britain would be troubled with this, or any similar, work. It would not be proper to criticise American building methods unfavourably because they differ from English methods; suffice it to note, that the authors have shown their knowledge and have exercised their skill and ungrudging labour in the preparation of the book. P. L. M.

Kamet Conquered. By F. S. Smythe. Pp. xvi+420+48 plates. (London: Victor Gollancz, Ltd., 1932.) 16*s*. net.

SEVERAL attempts had been made on Kamet before Mr. Smythe's successful expedition of 1931; so long ago as 1912 Mr. C. F. Meade discovered the best line of approach from the east by which he reached the mountain in the following year and gained an altitude of 23,500 ft., or less than two thousand feet short of the summit. Mr. Smythe's party used the same route by the East Kamet Glacier and Meade's col, reaching the top, 25,447 ft., with some difficulty but without accident. This volume, however, is more than a mere record of this and other climbs in the Himalayas. It contains a discussion of many of the problems of mountaineering, material, physiological and psychological. These reflections from an experienced climber are of great value and make the book of real use to future expeditions.

Identification of Vitamin C*

By PROF. A. SZENT-GYÖRGYI, Director of the Institute of Medical Chemistry, University Szeged

ABOUT a year ago vitamin C seemed to be the most elusive of vitamins, apparently defying all attempts at isolation and identification. To-day this substance can be bought at a relatively low price, neatly sealed in tubes, in the form of beautiful white crystals. It is even used as a reagent for reducing gold and silver in microscopical technique. Also its chemical constitution is cleared up to a great extent.

In spite of this, however, the development of our knowledge has not been so dramatic, and these results have been the outcome of laborious work extending over more than ten years. This vitamin was crystallised more than five years ago and was, so far as we know now, the first vitamin ever isolated in the crystalline form.

The development in our knowledge of vitamin C has taken place in four distinct steps. The first step was the observation of 'hexuronic acid' in 1927 and its subsequent isolation and partial identification at Cambridge in 1928. This observation and isolation in itself was the result of many years extensive studies on oxidation systems of plants and animals. I was led to these studies by the belief that the adrenal gland was in some way involved in oxidation processes. Before this function of the gland could be understood, more had to be known about oxidation itself. Thus oxidation systems were examined one by one, until a new oxidation system was brought to light in which the central rôle seemed to be played by an interesting substance with very striking chemical properties. This substance has been isolated and found to be a monocarboxy acid corresponding to the formula $C_6H_8O_6$. This formula, together with some qualitative reactions, suggested a relation with the hexuronic acid series. The substance was thus called 'hexuronic acid' and the oxidation system the 'hexoxidase system'. More recent results, however, obtained in Prof. Karrer's and Prof. Haworth's laboratories, do not bear out this relation to uronic acids and, I have proposed, in association with Prof. Haworth, to call it henceforth 'ascorbic acid'.

The most remarkable chemical property of this acid is its very high reducing power, unique among purely carbon compounds. This reducing power is the more remarkable, since the oxidation of the acid itself is reversible. It is in fact this reversible oxidisability by which the substance exerts its biological activity. It is oxidised and reduced alternately, giving off and taking up two atoms of hydrogen, thus acting as a hydrogen carrier between different parts of its oxidation system.

This same substance has been found in relatively large quantities in the adrenal cortex, of which it forms definitely a specific constituent.

The second step to the establishment of the chemical nature of vitamin C was the discovery of the antiscorbutic properties of ascorbic acid. The striking similarity in chemical properties and distribution of the acid and the vitamin has been evident since the discovery of the former. It was not, however, until the autumn of 1931 that, in collaboration with J. L. Svirbely at the Institute of Medical Chemistry at the University Szeged, I was able to find the necessary external condition for the test of the antiscorbutic activity.

Meanwhile evidence was accumulating that one of the reducing substances of plant juice and the vitamin were identical. Tillmans in Germany pointed out in his extensive studies the very close parallelism of both, not only in distribution, but also under different experimental conditions. In the end he arrived at the conclusion that the main reducing factor and the vitamin were identical. In the United States, C. G. King and his collaborators emphasised the reducing power and acidic nature of active fractions, while S. S. Zilva in England has also found many close parallelisms between reduction and antiscorbutic activity. This author, however, also found differences which have led him to believe that these factors are not identical.

Our first test, undertaken by J. L. Svirbely in the autumn of 1931, clearly brought out the antiscorbutic activity of 'ascorbic acid'. We were able to show, that not only had this acid a strong antiscorbutic activity, but also that the antiscorbutic activity of lemon juice corresponded to the activity of the quantity of ascorbic acid which it contained. Our results were not announced until March 1932, by which time the experiments were repeated three times with identical results.

At this time, March 1932, W. A. Waugh and C. G. King obtained crystals from lemon juice, which they thought to be identical with hexuronic acid and which seemed to have some action on the vitality of animals. Two months later the same authors were also able to present evidence for this identity and the antiscorbutic activity.

Our own experiments were checked at our request by S. S. Zilva and L. J. Harris and were confirmed. This evidence may be summarised by saying that all the preparations of ascorbic acid tested had strong antiscorbutic activity. The investigation had now arrived at a most difficult point. The question arose, whether the activity of the preparations was due to the ascorbic acid itself or to a contamination of the preparations with some more potent substance. The daily protective dose of ascorbic acid is 0·5–1·0 mgm. Should the crystals have contained 0·1 per cent of a substance, acting (as other vitamins) in doses of 1γ, their activity could be explained by this contamination. Our own substance employed in the test as well as the preparations of Waugh and King had a melting point 10° lower than that of pure ascorbic acid, and thus certainly contained more than 0·1 per cent impurity. This question, whether the activity is due to a definite substance or to contaminations, applies to all research on vitamins and is usually one of the most difficult problems to solve.

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*Substance of a lecture given at the University Club, Szeged, on December 15.

There is, however, much circumstantial evidence in favour of the identity of vitamin C and ascorbic acid. The parallelism in distribution and behaviour under experimental conditions, and the quantitative correspondence of the antiscorbutic activity of plant juice and its ascorbic acid content, point in this direction. Harris has shown that this quantitative correspondence holds also for the adrenal cortex with its high ascorbic acid content. Svirbely has shown that the ascorbic acid disappears from the gland very readily on vitamin-free diet, thus demonstrating the inability of the animal to build up this substance. Svirbely has also shown that our ascorbic acid, prepared from the adrenal gland, retained its antiscorbutic activity after five recrystallisations. Work on purely chemical lines alone could give direct and definite evidence of the identity of the vitamin and ascorbic acid. Unfortunately, the great scarcity of the material rendered such work impossible. Fresh adrenal glands, a convenient source for preparations, were not available in the necessary quantity, and all our efforts to prepare ascorbic acid from lemons, oranges, tomatoes, or cabbages on a large scale have failed.

In the third step in our work these difficulties were overcome and the way opened for direct chemical work, providing definite evidence for the identity of vitamin C and ascorbic acid. This progress we owe to the discovery that local varieties of Hungarian red pepper (*Capsicum annuum*) contain the acid not only in relatively large quantities but also under conditions which make its isolation exceedingly simple. It is due to this fact that during the last few months Svirbely and I have been able to prepare a full pound of crystalline ascorbic acid for chemical studies. Unhampered thus by the lack of material, we could set out with L. v. Vargha to study derivatives of ascorbic acid, an investigation which has led to the preparation of a mono-acetone derivative. This substance seemed to be almost ideally suited for our purpose. It forms big, beautiful crystals with great ease and is stable in anhydrous solution, from which it can be recrystallised without difficulty. After due recrystallisation the original acid can be recovered unchanged by simply boiling it in water for a few minutes. Since the acetone derivative does not hydrolyse in cold water immediately, it was found in the antiscorbutic experiment to be but moderately active. The ascorbic acid, recovered from the recrystallised derivative, was fully active, a definite evidence for the identity of ascorbic acid and the vitamin.

The last and perhaps the most difficult step towards the definite chemical identification of the vitamin is the establishment of the chemical constitution of ascorbic acid. The possibility of preparing ascorbic acid in quantity has also opened the way for the chemical analysis. It was a great privilege for my American collaborator Svirbely and myself to be allowed to supply material to Prof. Haworth at Birmingham and Prof. Karrer at Zurich for this analysis.

The work of the laboratories at Zurich and Birmingham has clearly brought out that ascorbic acid is, confirming my original findings, a simple substance, consisting of 6 carbon, 8 hydrogen and 6 oxygen atoms; it contains one carboxy group, but is, however, not a member of the uronic acid series, and thus is not a hexuronic acid. Two of the carbon atoms are present as $C = O$ groups forming a keto or aldehyde group with strong enolisation. One carbon is present as CH_2. The remaining two carbon and oxygen atoms are present as alcoholic groups. In this way the essential features of the molecule are cleared up and there remains only to ascertain the relative position of these groups.

It is hoped that the fact that the vitamin is a specific constituent of the adrenal cortex, from which it disappears on vitamin-free diet, will open up many fascinating problems to research and may contribute to the deeper understanding of the relation of hormones and vitamins.

There is one aspect of these investigations on which I look with pride and gratitude. This work has been made possible only by the closest international collaboration. It has been helped by Dutch, English and American hospitality and generosity. At present it is aided by the Josiah Macy, Jr. Foundation.

Geology in the Life of a Nation

THE Indian Science Congress held its twentieth annual meeting this year at Patna under the presidency of Dr. L. L. Fermor, Director of the Geological Survey of India. In his presidential address Dr. Fermor refers to some matters of general interest in the history of the Indian Science Congress, which is modelled on the lines of the British Association, and, like that body, meets annually at different towns.

The initial meeting that led to the formation of the Congress was held in 1912 in the rooms of the Asiatic Society of Bengal and that Society has since taken the general responsibility for the organisation of the Congress year after year. Until 1931 the Congress had no permanent organisation, but a constitution was then adopted whereby it did become a continuous organisation under the title of the Indian Science Congress Association with a roll of permanent members—though the close association with the Asiatic Society of Bengal is to be maintained. Dr. Fermor appeals to generous donors to remember the Indian Science Congress now that it has an independent existence, since it is hoped that in the future it may have funds for financing special items of research.

Special mention is made of the new periodical *Current Science*, the first issue of which as a monthly journal appeared in July 1932. This periodical has been modelled on the lines of NATURE and there has been no lack of material suitable for publication, but the financial position of the new venture at present leaves much to be desired, though this all-India journal of science can be self-supporting with a minimum of five hundred subscribers.

It is certainly very clear that the Indian Science Congress has fulfilled a want. At the first meeting there were 79 members, a presidential address was given, and 35 papers were read, and the published proceedings occupied eight pages of print. At the nineteenth meeting in 1931 the number of full and associate members was 690 and of student members 183. There were ten presidential addresses, general and sectional, and 693 papers were communicated occupying 467 pages of *Proceedings*.

In choosing as the subject for his presidential address, "The Place of Geology in the Life of a Nation", Dr. Fermor has left the sting of his remarks to the tail. All the countries of Europe, excluding Russia, Finland, Scandinavia, Poland, Greece and Turkey can be fitted into the area of India excluding Burma. The Geological Surveys of the various European countries have staffs numbering more than 250, of which 78 are employed in Germany and 52 in Great Britain. Yet for the adequate geological survey of a corresponding area, the staff of the Geological Survey of India has just been cut down in a most drastic way. It now has only 24 officers, 6 of whom are employed in Burma, leaving only 18 for the whole of the vast area of India. It is small wonder, therefore, that the Director of the Geological Survey should seek to analyse the position which geology should occupy in the life of a nation. In so doing he interprets geology as geographical evolution and states that "geography is the branch of geology that describes the particular shape and form of the earth's surface at the present time".

Although there are few geographers who would accept this definition, they would heartily agree with Dr. Fermor upon the necessity for a detailed study of that portion of the human environment which comes within the domain of the geologist. The position of the capital of India has been dictated by the physical structure of the subcontinent, which in turn depends on its geology. Similarly, the position of the commercial capital, Calcutta, dependent as it is on the nature and extent of its hinterland, has been similarly determined. The black earth region that forms the natural hinterland of Bombay and provides the Bombay cotton mills with their huge supplies of raw cotton, depends in turn upon the existence there of the black soil derived in the main from the Deccan lavas. The close correspondence between the political map of Europe and the orographical and geological is emphasised and it is in particular pointed out how the less stable political units of Europe are those which are less clearly natural geographical or geological units. "India is fortunate, however, in that the general geological conditions have caused the inhabitants, in spite of their diversity of race, religion and language, to be welded after struggles through the ages into one political unit. As the national boundaries in central Europe, the boundaries between the provinces in India pay little attention in many cases to geological considerations. The province of Bihar and Orissa, for instance, . . . is an excellent example of the violation of natural principles by provincial boundaries. But as long as the central political control remains, it does not matter seriously that the boundaries of our provinces take such little account of natural factors. Were the central control, however, removed and all political relationship to one general suzerain power severed, then the future history of India would again become as confused as it was in the past and as confused as that of Central Europe has been throughout the ages and promises to become again in the future."

This is truly the geographer's point of view and it is interesting to find it so clearly voiced by a geologist. There is an unhappy note when Dr. Fermor says towards the end of his address that "at present the scope for new employment for geologists in India has fallen almost to zero". He urges, however, the continued need for geological classes in university institutions as a "branch of general culture".

One cannot regret feeling that Dr. Fermor has not been able, because of his official position as director, to add point to his arguments by reciting some, at least, of the great work which has been carried out by the Geological Survey of which he is head. So it is to be feared that the reduction of this essential service in such an amazingly drastic fashion has passed without the notice that it should have attracted from men of science. For the Survey has a great and continuous record of work and it is to be hoped that under Dr. Fermor's guidance it will force an adequate recognition of its services to the country.

This is not the place for reciting what the Survey has done, but perhaps its Director may be able to remove what have in the past been two of the major criticisms: (1) the perhaps rather inadequate means of publication of the detailed mapping carried out by the officers, whose work in this respect remains unknown even to geologists in India itself, while there is apparently nowhere in Britain where the one-inch maps, on the preparation of which a large proportion of the officers' time is expended, can ever be consulted; (2) the serious time lag between field-work and publication, especially important where problems of economic geology are being investigated.

L. DUDLEY STAMP.

Tercentenary of Samuel Pepys

By T. E. James

THE three hundredth anniversary of the birth of Samuel Pepys, a moving, dramatic figure in the political and social annals of the Restoration period, falls on February 23. Born either at Brampton, near Huntingdon, or in London (so records say), he was educated at St. Paul's and Magdalene College, Cambridge, graduating there in 1660. In 1655, Pepys married and had, for some time, to face comparative poverty. He was favoured, however, with the patronage of Sir Edward Montagu, and was employed as secretary to the expedition for bringing Charles II from Holland; this leading to permanent and official employment at the Admiralty. In 1679 Pepys was committed to the Tower on a State charge, but was incontinently released.

Pepys's "Diary" was begun on January 1, 1659-60. It was written in great secrecy. The final entry was made on May 31, 1669. The "Diary" itself was not published until 1825. Therein, the high intent, the ignoble, and the frailties of Pepys's own life resolve into an inexplicable, baffling display of inwardness.

Not the least monument to Pepys, where memory is deep and lasting, was the bequest of his library and MSS. collections (by preference) to Magdalene College, Cambridge. An excellent general account of the Pepysian Library has been given by H. B. Wheatley (1880).

During the early part of Charles II's reign, the Royal Mathematical School of Christ's Hospital, still part of the major foundation, was established. Pepys, as a governor, took a lively interest in its efficient administration. On February 15, 1661-2, Pepys was made a younger brother of the Trinity House and in 1676, Master of the Trinity House. He was elected Master of the Clothworkers' Company in 1677.

Readers of NATURE will be more particularly interested in the association of Samuel Pepys with the Royal Society of London in its early days, particularly with those men who had been most active in its institution. In course of time we witness Pepys's own inclusion in the organisation; ultimately, his assumption of the office of president.

We need entertain no doubt that Pepys was cognisant of the various steps that were taken to establish the Society. He had friends of quality, who would relate what had happened, whilst Pepys himself, Clerk of the Acts (Navy), was favoured in the Restoration Court circle, where news spread apace. Hence, on January 9, 1664-5, Pepys is able to record that the Royal Society's charter book had been brought to Whitehall, and that the founder's signature and that of the Duke of York were duly inscribed. Indeed, he had not long to wait for acceptance amongst the philosophers. On February 8, 1664-5, "Samuel Pepys, Esq., was proposed candidate by Mr. Povey", the business prior to this being the election of Edward, Earl of Clarendon, the famous Lord Chancellor. Mr. Pepys found himself in excellent company. Thomas Povey, it may be mentioned, was an original fellow. He had mechanical gifts and for many years proved serviceable to the Society. Evelyn considered him to be "a nice contriver of all elegancies".

On February 15, 1664-5, Pepys was duly elected, signing the charter roll then and there. Going home, Pepys recorded his experience thus:—

> "With Creed to Gresham College, where I had been by Mr. Povy; and the last week proposed to be admitted a Member, and was this day admitted, by signing a book and being taken by the hand by the President . . . and some words of admittance said to me. But it is a most acceptable thing to hear their discourse, and see their experiments. After this being done they to the Crowne Taverne, behind the 'Change, and there my Lord and most of the company to a club supper; . . . Above all, Mr. Boyle to-day was at the meeting, and above him Mr. Hooke, who is the most, and promises the least, of any man in the world that ever I saw."

Pepys chronicles, as also amongst the company, Sir Paul Neile, Sir Robert Moray, Dr. Clarke, Dr. Whistler, and Dr. Goddard. On March 1, following, the subjoined entry occurs:—

> "At noon I to dinner at Trinity House[*], and thence to Gresham College, where Mr. Hooke read a second very curious lecture about the late Comett[†]; among other things proving very probably that this is the very same Comett that appeared before in the year 1618, and that in such a time probably it will appear again, which is a very new opinion. . . . Then to the meeting. . . ."

In the following week (March 8), Pepys goes to the weekly meeting as a fellow. A letter was read from Huyghens to Sir R. Moray, containing first his desire to be more particularly informed about the pendulum watches committed to Major [later Sir Robert] Holmes. Mention was thereupon made of Holmes's relation of the performances of pendulum watches on his voyage to Guinea, and doubts were cast. Accordingly, Mr. Pepys was asked to inquire into the matter for the satisfaction of the Society. On March 15, Pepys gave an account of information that he had obtained from the master of the Jersey ship who had sailed with Holmes on the Guinea voyage. Something additional devolved on Pepys. He was desired to bespeak a man at Deptford for diving. The diver was to be sent to Robert Hooke to be instructed by him concerning the use of "air-boxes" under water. Later, in May, Lord Brouncker reminded

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[*] The Navy Office, where Pepys resided, lay between Crutched Friars and Seething Lane, by the Tower.

[†] See in this connexion, NATURE, Feb. 7, 1884, p. 345, article in "Our Astronomical Column".

Pepys of this commission, as the season was favourable. On March 22, the subject of Holmes's watches arose, and Pepys was requested to procure the journals of those masters of ships who had been with Holmes in Guinea and differed from him.

The incidence of the Plague and the Great Fire which followed were periods of intensive public anxiety and apprehension, and we lose contact with the College world for some time. But on November 14, 1666, Pepys records that Dr. Croone had told him that at that night's meeting, "which, it seems, they now have every Wednesday again", there were experiments on blood transfusion. A year later (November 21, 1667), there is another reference :—

> . . . "I to the office, where did much business till after candlelight, and then my eyes beginning to fail me, I out and took coach to Arundell House, where the meeting of Gresham College was broke up ; but there meeting Creed, I with him to the taverne in St. Clement's Churchyard."

On November 30, 1667, Pepys tells us that he went to Arundel House to the election of officers of the Royal Society for the next year ; that he was near being chosen, but glad that he was not, for he could not have attended, but took it as a mighty respect to have been named. Also, that the company was great, the elections long.

On April 2, 1668, Pepys mentions a visit to the Royal Society, with Lord Brouncker, and of being "forced to subscribe" to the building of a College ; and that he "did give forty pounds". Pepys held views adverse to the scheme, and these may have reflected themselves in a partial withdrawal of interest, for not until November 30, 1674, do we again pick up the threads of association with the Society. But it is with enhanced prestige. At the anniversary meeting, Mr. Pepys is among ten new members chosen for the council. His ally, Sir Joseph Williamson (P.R.S., 1677), was also of the number. Pepys attended the meeting on December 3, when a resolution was taken that every member of council should provide an experimental discourse for the Society, to be made within the year, either by himself or by some other member of the Society ; *or*, "to pay forty shillings". Pepys promised a discourse.

On December 17, Pepys is placed upon a committee to consider how Dr. Wilkins's legacy of £400 might be laid out. Also, he was joined with Sir R. Southwell and the president in an application to Prince Rupert "concerning the mischief which his glass-house does to Chelsea College". In January ensuing the president announced his discourse. Mr. Pepys, he said, had offered to make his the next week after his own ; it does not appear, however, that Pepys held to his offer.

On February 18, 1674–5, "Mr. Isaac Newton" was admitted a fellow. Since Pepys was a member of council, there is a presumption that he was present on this particular occasion. Pepys was irregular in his attendances, however, during the year, and he was not continued on the council. But his light was only temporarily dimmed, for on November 30, 1676, he re-appears as one of ten new members, and among these were Sir Christopher Wren and John Evelyn. Again Pepys served twelve months.

In the politically stormy year of 1680, "far away at Newmarket, Pepys was taking down, at the dictation of his sovereign, the tale of that miraculous escape from Worcester of twenty-nine autumns before" (Bryant).

We now pass to the year 1681, when Pepys re-appears in the Royal Society. At the anniversary meeting on November 30, he enters the council, and with him, Evelyn and Flamsteed ; Sir Christopher Wren is president. Hooke was a colleague. Pepys served for one year. Coming to 1684, at the anniversary meeting on December 1 (St. Andrew's Day falling on a Sunday), Sir John Hoskyns in the chair, Samuel Pepys, chosen for the council, is also elected president of the Society. Notwithstanding that his attendances were infrequent, he was, in 1685, continued in the presidency for yet another year, this nomination marking the closing and final period in that office.

Here it may be mentioned that at a council on June 2, 1686, the first book of Newton's "Principia" was ordered to be printed. Pepys was not present, nor on June 30, when it was ordered that the president be desired to license the book. Sir John Hoskyns occupied the chair. Pepys's imprimatur was given on July 5.

Samuel Pepys was never a very healthy man, and he died at Clapham on May 26, 1703. He was buried in St. Olave's Church, Crutched Friars. His portrait, by Kneller, and his own gift, adorns the apartments of the Royal Society.

Obituary

PROF. HARLAN W. FISK

THE science of terrestrial magnetism has lost an outstanding investigator and the staff of the Carnegie Institution of Washington an esteemed member by the sudden death, on December 26, of Prof. Harlan Wilbur Fisk, chief of the Section of Land Magnetic Survey of the Institution's Department of Terrestrial Magnetism. During his long period of service with that organisation, extending over more than a quarter-century, he contributed much to the success of the world magnetic survey both by personal participation in the observational work and by planning and supervising the work at repeat-stations for obtaining data where most needed for investigations in his complex field.

Prof. Fisk was born at Geneva, Kansas, on September 25, 1869, but his youth was spent in Minnesota where he received his fundamental scientific training at Carleton College, Northfield. Here his enthusiasm for mathematics and astronomy was awakened by contact with such inspiring teachers as W. W. Payne and H. C. Wilson. In 1899 he was appointed professor of mathematics at Fargo College (North Dakota). It was here that the problem of terrestrial magnetism first engaged his attention and he devoted his summer vacations (1904–6) to magnetic observations for the United States Coast and Geodetic Survey in the north-central and western States. His interest in this field grew so rapidly that in October 1906 he adopted it as his life work when he became associated with the Department of Terrestrial Magnetism.

Here Prof. Fisk focused his activities on the land magnetic survey—one of the major undertakings of the Department. He made two detailed surveys of the Bermuda Islands, in 1907 and 1922, and in 1908 conducted magnetic expeditions in Central America, in the West Indies, and in the northern countries of South America. He was also greatly interested in the investigations of possible eclipse effects on the earth's magnetic field and participated in several eclipse expeditions of the Department—the last was on the occasion of the eclipse of August 21, 1932, when he was in charge of three observing parties in New England. He took a prominent place in the instruction of many of the Department's most active observers and in the laborious observations during many years in Washington, D.C., relating to the control of instrumental outfits and the determination of the provisional international magnetic standards.

Prof. Fisk's chief research contribution was the investigation of secular changes in the earth's magnetism and of the shifting of isoporic foci disclosed by magnetic data obtained at strategic repeat-stations by observers under his supervision. Mature deliberation led him to infer that secular changes in the earth's magnetism determined by observations on its surface might reflect changes within the earth's crust or interior. At the time of his death, he had in preparation an exhaustive paper on this subject.

Besides membership of a number of scientific societies, Prof. Fisk was an active worker in the American Geophysical Union, being secretary of its Section of Terrestrial Magnetism and Electricity in 1929–32. Because of an unusual breadth of culture extending far beyond the confines of his scientific activity, it was his pleasure and privilege to render important service to his community in its civic and religious life. His quiet disposition, generous nature, and helpful counsel, won him the esteem of his colleagues and friends. Those who shared his acquaintance and work, will mourn with his widow and four children his premature passing.

H. D. HARRADON.

MR. B. H. SOULSBY

MR. B. H. SOULSBY, who died at Reading on January 14, aged sixty-eight, was for nearly thirty-eight years in the service of the Trustees of the British Museum, first at Bloomsbury and later at South Kensington. He was educated at Cheltenham College and at Corpus Christi College, Oxford, and also studied at Göttingen. He entered the service of the Trustees as a second-class assistant in the Department of Printed Books in 1892, and became successively superintendent of the Map Room, of the Copyright Office, and finally deputy superintendent of the Reading Room. During his time at Bloomsbury, he catalogued the library of the Grand Priory of the Order of the Hospital of St. John of Jerusalem in England, and translated some early geographical works. In 1902 he published a small pamphlet on the earliest two maps which bear the name America.

In 1909 Mr. Soulsby was transferred to the Natural History Museum as assistant in the Director's office, and in January 1921 he was appointed librarian in succession to the late Mr. B. B. Woodward. His principal official duty was to continue Woodward's Catalogue of the Natural History Library, a monument of bibliographical care and research and a mine of information, the value of which was recognised far beyond the limits of the Library to which the work refers. Woodward had compiled six volumes and one supplementary volume, and at the time of Mr. Soulsby's retirement, the second supplementary volume was well on the way to completion.

At the time of his death, Mr. Soulsby was seeing through the press the final stages of a revised, second edition of the "Catalogue of the Works of Linnæus . . . in the British Museum". The first edition, which was compiled by B. B. Woodward and W. R. Wilson, was a quarto publication of 27 pages, comprising some 580 entries. The second edition will contain about 300 pages of text, with nearly four thousand entries, accompanied by bibliographical notes, plates and an index.

It was upon this index that Mr. Soulsby was engaged, with his accustomed industry and enthusiasm, at the time of his death. The forthcoming publication of this Linnæan Catalogue is a matter of great interest to librarians in Sweden, from several of whom Mr. Soulsby obtained considerable assistance in its preparation. The compiler used to claim that the collection of Linnæana at South Kensington was second only in richness and importance to that at the Royal University Library of Uppsala, and if this is so, it is largely due to Mr. Soulsby's great generosity, inasmuch as ever since he undertook the work of producing a second edition of this catalogue, he was continually presenting rare and costly Linnæana to the library at South Kensington.

MR. J. L. S. HATTON

JOHN LEIGH SMEATHMAN HATTON, who died on January 13, aged sixty-seven years, was the first principal of East London College and, at the time of his death, Vice-Chancellor of the University of London. He was born at Street Aston on May 27, 1865, the son of the Rev. J. L. S. Hatton, rector of West Barkwith, Lincolnshire. He died at his home at Sanderstead, Surrey, and is survived by his widow and two sons.

Mr. Hatton entered Oxford with a scholarship at Hertford College and obtained a first class in the school of mathematics in 1889 and a second class in natural science (physics) in 1890. He acted for a short time as demonstrator in the Clarendon Laboratory and was called to the Bar by Lincoln's Inn.

In 1892, Mr. Hatton began to organise the day and evening teaching work of the People's Palace in Mile End Road, and by his unremitting effort and enthusiasm, supported by the interest and encouragement of the Drapers' Company, he built up an institution which, in 1907, became East London College, a school of the University of London, with day courses leading to degrees of the University in the faculties of arts, science and engineering. Mr. Hatton became a member of the Senate of the University in 1903, representing the faculty of science, and continued in this office until on the reconstitution of the University, he became a member *ex officio*.

Mr. Hatton's work for the University was as thorough and valuable as that for his own College. He was dean of the faculty of science from 1922 until 1926, chairman of the Board of Studies in Mathematics for many years, was elected deputy Vice-Chancellor in 1930, and assumed the office of Vice-Chancellor last September. He was for many years head of the Mathematical Department at East London College, and was appointed University reader in geometry in 1927 on his retirement from this post. He was the author of several mathematical works, including "The Theory of the Imaginary in Geometry", but his main interests were in teaching and administration.

MR. WILLIAM H. V. WICKES of Bristol died on February 2, aged eighty-six years. Wickes was a well-known local geologist and had been guide, philosopher and friend to many of the older school, British and foreign. He wrote short papers on the Rhætic bone-bed and the mineral beekite and made a varied collection, passing his best things on to the British and the Bristol Museums.

WE regret to announce the following deaths:

Prof. Johan van Baren, professor of geology and mineralogy in the Agricultural University of Wageningen, Holland, an authority on soil mineralogy, on February 7, aged fifty-seven years.

Lieut.-Col. J. C. G. Kunhardt, formerly of the Indian Medical Service, who did valuable work on plague prevention in India, and also in the advancement of the rubber industry, aged fifty-seven years.

Prof. A. G. Leonard, professor of geology in the University of North Dakota and State geologist, on December 17, aged seventy-seven years.

Sir Daniel Morris, K.C.M.G., assistant director of the Royal Botanic Gardens, Kew, in 1886–98, and president of Section K (Botany) of the British Association in 1919, aged eighty-nine years.

Prof. Ormond Stone, director of the McCormick Observatory and professor of practical astronomy in the University of Virginia from 1882 until 1912, on January 17, aged eighty-six years.

Sir J. Arthur Thomson, formerly regius professor of natural history in the University of Aberdeen, who was widely known as a writer and lecturer on natural history, on February 12, aged seventy-one years.

News and Views

Gold in Kenya

THE debates on the amendment of the Kenya Native Lands Trust Ordinance in both Houses of Parliament on February 8 did little to remove apprehension as to the manner in which the exclusion of land from the reserves is likely to affect the native population. The motion for papers moved by Lord Lugard in the House of Lords was withdrawn; and the amendment of Mr. Lunn to Mr. Donner's original motion, approving the action of the Government of Kenya in the steps taken to develop the goldfields and safeguard the interests of the natives, was defeated by a majority of 151. The case against the amendment of the Ordinance, as accepted by the Kenya legislature, was stated lucidly by Lord Lugard, who was ably seconded by the Archbishop of Canterbury; while in the House of Commons Sir Robert Hamilton gave an emphatic, but temperately phrased, expression to the feeling of uneasiness which has been aroused by the manner in which the Government has handled the situation. It cannot be said that the Government has given a satisfactory reply to its critics. The main contention, that the exclusion of land from the reserve without a compensating grant of additional land is a breach of faith and will be detrimental to tribal life, has not been met. However convincingly it may be argued on this ground or on that that there has been no real departure from the undertaking of the Ordinance, either in letter or in spirit, it is the native point of view that counts in this connexion. As Sir Robert Hamilton said, if the confidence of the native in the good faith of the Government be shaken, "in the long run we shall lose more than will be repaid by all the gold in Africa".

THE voting in the House of Commons was no doubt largely affected by the stress laid by Sir Philip Cunliffe-Lister on the small number of individuals and the relatively small area of land affected by the present proposals, as well as by the anxiety of the Government and of the local administration to make it clear that it is their desire not only that the native should not suffer, but rather that he should benefit from the stream of prosperity which will flow in his direction. On these points two comments may be made. First, that it was unfortunate that Sir Alfred Kitson's report on the applications for concessions now under consideration did not come within the terms of the debate. This report shows that ultimately an area of at least five thousand nine hundred square miles will be in question; and now it would appear that part of Kikuyu may be affected. On what terms will the development of these areas be undertaken? Secondly, a prosperity which is detrimental is illusory. The prosperity to come was contrasted by one speaker in the House with the miserable conditions of the natives to-day. But if, apart from a temporary economic crisis, the present-day conditions are in harmony with tribal traditions, a sudden accession of prosperity, for which the social organisation is not yet ready, will give rise to graver problems, similar to those now the cause of anxiety elsewhere in Africa. We are asked to trust the goodwill of those on the spot, whose relations with the native are said to be excellent. Goodwill is of little avail when question arises of interference with native custom, unless it accompanies scientific knowledge, such as can only be gained, as any anthropologist will point out, after prolonged and intensive study. Without such knowledge, modification of tribal custom always involves the danger of detriment to the social organism as a whole. Yet it is on the preservation and gradual development of that organism that the future of the native population depends.

New Record for Non-Stop Flight

A FAIREY long-range monoplane (Napier Lion engine), flown by Squadron-Leader O. R. Gayford and Flight-Lieut. G. E. Nicholetts, beat the world's long-distance non-stop flight record on February 6–8, flying from Cranwell, Lincolnshire, to Walvis Bay, 781 miles north of Cape Town. The distance of 5,340 miles was covered in 57 hours 25 minutes. The previous record was 5,012 miles from New York to Constantinople. The machine followed approximately the shortest great circle course, making detours to avoid the Atlas mountains in Northern Africa and the Ahaggar plateau in Central Sahara. The ideal weather conditions of a westerly wind at Cranwell for take off, and a following northerly wind for the rest of the journey, with clear weather and a full moon over Africa, were experienced for the first part of the journey. Later, unfavourable weather and winds over Nigeria and Duala hindered progress sufficiently to make it impossible to reach Cape Town because of lack of petrol and the approach of dusk.

As equipped for this flight the monoplane carried about 8,000 lb. of petrol and weighed about 17,000 lb. total weight. A specially prepared run-way of one mile was used at Cranwell, the machine running 1,600 yards in 58 seconds before taking off. It was fitted with an autogyroscopic control which not only relieves the pilot of the strain of continuous flying, but assists accurate course keeping. This broke down during the latter part of the flight. A short wave (33·71 cm. wave-length) wireless transmitting set was used to report progress but no receiving set was carried. This gave variable results; messages were picked up over considerable distances but some were undecipherable. The flight was carried out by the Royal Air Force as part of a general policy of development of long-distance air transport for strategic purposes. Not only will the behaviour of the aircraft, engine and instruments be carefully examined, but the medical department is investigating the effects of such flights upon the personnel engaged. The special food carried was chosen by the medical authorities.

John Thompson

CHARLES HUTTON, when engaged in editing the "Diarian Miscellany" in 1775, regretted the insufficiency of biographical material for the lives of the mathematicians responsible for the problems that appeared every year in the eighteenth century almanacks known as the "Gentleman's" and "Ladies'" "Diaries", which were edited by Henry Beighton of Griff from 1714 until 1744, with the assistance of Anthony Thacker, and later by Robert Heath, 1745–53. One of their collaborators was John Thompson of Witherley Bridge in Leicestershire, the hundred and fiftieth anniversary of whose death falls on February 25. By good fortune his surveying instruments, until recently in the possession of his descendant, Mrs. Alkin of Atherstone, are still extant and have been presented by the Friends of the Old Ashmolean to the Lewis Evans Collection at Oxford. They show that Thompson was a practical inventor and improver of instruments as well as a mathematician. It is stated in Nichol's "History of Leicestershire" that Thompson, on leaving Atherstone School, had been intended by his father for the farming and grazing business, but the boy's innate love of mathematics was so strong that, with the collusion of his mother, he surreptitiously purchased a few mathematical books and studied them where and when he could, generally at night. He was helped by Beighton and Thacker, and contributed articles to various journals. When Atherstone common fields were enclosed in 1765, an error by the Commissioners led him to propose a prize question (No. 290) in the "Gentleman's Diary" for 1766. It had been agreed that the small cottages should have a plot known as Cottagers' Piece in the shape of two trapezia to contain 100 acres. Thompson was asked to resurvey it and found it three acres too large, on which he based his prize question, as he said, "that the error of these unmathematical Bunglers may be known".

THOMPSON'S instruments include two levels by Thomas Wright, one dated 1724, a cross head by J. Scarch with one quadrant graduated, an early Gregorian telescope, chains, and the usual slide rules, scales and drawing instruments, and, most interesting of all, a superb plane-table and tripod designed by John Thompson himself, and inscribed "Made by G. Adams in Fleet St. London. Inst: Makr: to His Royal Highness the Prince of Wales." It is surrounded by inlaid brass scales, and measures 18½ in. across.

By a special tilting arrangement the table can be adjusted at any desired angle. It is provided with marginal sights, and adjustable rules which can be raised by screws or depressed level with the surface of the board. The magnetic compass box is of the shape of a figure 8, and the card is only graduated for 45° on each side of the north-south line. It is the most perfectly designed and executed plane-table which we have seen. Two note-books show that he was instructing his sons Ralph and Samuel in the art of surveying in 1773 and 1778 respectively. Ralph Thompson also became an accomplished surveyor, and an example of his work made in 1812, a survey of the Roman town of Manduessedum on Watling Street, is reproduced in Nichols's "Leicestershire".

Nest-Building of Brush-Turkeys

An early visit to the gardens of the Zoological Society of London is recommended in order to inspect the initial stages in the nest-building of the brush-turkeys, on the north bank of the Canal. The labour of forming the vast mound of leaves, in the centre of which the eggs are laid, is performed by the male. Here they are left until they hatch by the heat generated by the fermentation. The eggs being of great size in proportion to the size of the bird, the early, 'nestling-down', stage is passed within the shell, the down being shed before hatching. By the time this takes place the birds are strong enough to force their way out, and emerge with fully developed flight-feathers. This singular phase in the infancy of birds is confined to the Megapodes, of which there are many species. But some bury the eggs in hot sand, instead of decaying vegetation. The recently added 'piping-crows' from Australia, which are more nearly related to the drongos and swallow-shrikes than to the crows, and that singular fish the climbing-perch (*Anabas*), are also worth a visit.

Physical Nature of the Nerve Impulse

AT the Friday evening discourse held at the Royal Institution on February 10, Prof. A. V. Hill discussed the physical nature of the nerve impulse. The properties of the nervous system are based upon a certain transmitted wave which is known as the nervous impulse. This wave, which is a few centimetres long, travels in nerve fibres of the order of 0·01 mm. in diameter with velocities varying from a few centimetres to 100 m. per second. Its nature is not yet understood, but it possesses certain well-defined physical characteristics. The chief difficulty in investigating it is the minuteness of the changes involved in its passage: there is, for example, a rise of temperature, but this is only of the order of one ten-millionth of a degree for each impulse, while the chemical changes which accompany this are at present altogether beyond detection. Fortunately, owing to the development of modern electrical methods, the electrical accompaniments of the wave can be accurately recorded, and the study of the so-called 'action current' has thrown much light on the process. The nature of electrical excitation has been discussed for many years, and it seems that 'activity' is produced when the current through the nerve fibre surface exceeds a certain value at the cathode. The 'activity' seems to consist of an alteration in the physico-chemical properties of the surface layer, allowing reaction to take place momentarily between inside and outside. The change is rapidly reversed, and the nerve is then ready to transmit another impulse. The passage of the wave involves the liberation of energy during, but chiefly after, the active process. Recovery lasts 30–50 minutes and requires oxygen. In other respects, however, the nerve impulse possesses wave-like properties, and its further investigation by physical means is likely to lead to a far greater understanding of nervous processes and of the phenomena of living activity in general.

Scientific Progress and Ethics

IN the *Journal of the University of Bombay* (Sept. 1932), under the title "Is Man Ethically Fit for the Bounties of Science?" Prof. D. D. Kanga of Gujarat College, Ahmedabad, comments on a convocation address by Sir C. V. Raman on the study of science. Asserting that true scholarship goes hand in hand with research, independence of thought and original thinking, Sir C. V. Raman said that the function of a university is the encouragement of the human intellect and the human spirit in their highest manifestations. The greatest value of science lies not so much in the imparting of knowledge about natural phenomena and the laws of Nature, as in the teaching of the scientific method which has served as a powerful weapon in the hands of man in the discovery of truth and has given him a new view of the universe he lives in. If the same method were used in the problems of daily life, whether political, industrial, social, educational, or religious, it would usher in a new era of progress and enlightenment in all the departments of life. Prof. D. D. Kanga, reviewing the sabotage which has accompanied increased productivity consequent upon the application of modern science, directs attention once more to the problem of distribution, which he reminds us is largely a matter of the individual will. It is the duty of every university to see that the advance of science and the spread of scientific culture go with a parallel advance in man's ethical and spiritual development. The motto of science should be truth and service, and the alumni of a university should be characterised alike by their ability to apply the scientific method in all problems of life and also, in Prof. Kanga's view, by their readiness to share their knowledge, wealth, power and possessions with others, of whatever race or country, for the common good.

Persepolis

THE archæological expedition to Persepolis of the Oriental Institute of the University of Chicago, one of the eleven expeditions of the Institute now at work in the East, has achieved some remarkable results in its second season's work on the site. Indeed, Dr. J. H. Breasted, director of the Institute, in a comment appended to an abstract of the report by

Dr. E. Herzfeld, field director, which appears in the *Times* of February 4, says that no discovery like it has ever been made anywhere in western Asia. A magnificent series of sculptures, dating back to the time of Cyrus, has been discovered in the area of the palace burnt by Alexander the Great in 330 B.C. The size alone, without taking into account the technique and the informative detail, is overwhelmingly impressive. One panel, 5–6 ft. high, is no less than 1,000 ft. long. The carvings are as fresh as when executed and show rulers, footmen, horsemen, charioteers, servants and burden-bearers in full equipment—material of the greatest historical value. One panel preserved in peculiarly favourable circumstance still shows the colours of the royal garments. A find of no less importance to the prehistorian is recorded in an account of a stone age village which was found under a low mound within two miles of Persepolis. It is dated at about 4000 B.C. and would appear to be in an excellent state of preservation. The mud-brick walls of the houses still stand to a height of 5–7 ft. and the interior surfaces show mural paintings in red water colour. The polychrome pottery, Dr. Herzfeld reports, exceeds in beauty and age that found in Babylonia, marking "a new chapter in the history of prehistoric art".

International Congress of Ethnological and Anthropological Sciences

CONSIDERABLE progress has been made in the discussion of the proposal to institute an international congress of the ethnological and anthropological sciences. Arrangements are now being made for a preliminary conference for further discussion to be held in Basel on April 20–22 next. Invitations to the conference are being issued by the Royal Anthropological Institute of Great Britain, while the local arrangements are in the hands of Dr. Felix Speiser, director of the Museum of Ethnology, Basel. The conference will be welcomed on behalf of the City and the Education Committee, and its sessions will be held in the Burgeratsaal. The subjects for discussion by the conference are the scope of the proposed congress and its relation to existing congresses of like character, such as the International Congress of Americanists and the International Congress of Prehistoric and Protohistoric Sciences; constitution and procedure; and the date and place of the first meeting. On this last point, it has been suggested that meetings should take place in years alternate to those of the Prehistoric and Protohistoric Sciences Congress and coinciding once in every four years with the European meetings of the Americanists' Congress.

Insect-Eating in Siam

INSECT-EATING habits of monkeys have persisted, and still persist, not only amongst the most primitive races of mankind, like Australian aborigines and the African pygmies, but even in many races which have reached the agricultural stage. An interesting example is offered by the Laos of Siam, whose habits of eating insects and other invertebrates have been recently studied in some detail by Mr. W. S. Bristowe (*Trans. Entom. Soc. Lond.*, 1932). The list of animals used as food by the Laos includes many species and exhibits a great variety, but certain of them are considered as special delicacies. Here belong, for example, giant water-bugs (*Lethocerus indicus*), measuring about two inches in length and fetching up to 4*d.* a piece on the markets; large spiders, *Nephila maculata* and *Melopoeus albostriatus* ('bird-eaters'); eggs of king crab, *Tachypleus gigas*, which look like caviare, but taste like potato; larvæ, pupæ and adults of the dung beetles, *Oryctes rhinoceros* and *Helicopris sp.*; a large cicada, *Dundubia intemerata*; etc. There is no reason to think that insect-eating habits of the Laos were acquired owing to the lack of other food, since the Siamese living under the same conditions do not eat insects to such a great extent. On the other hand, it is interesting to note that the Laos are considered to possess greater stamina and to be harder workers than the Siamese; this may be due to the extra protein obtained by the Laos from their animal food. The average diet of a Siamese includes fish as practically the only source of protein; the protein content of fish is 18–23 per cent, and that of roasted spiders is so high as 63·4 per cent.

Fauna of the Swiss National Park

THE area of mountain, forest and valleys comprising the Nature reserve which forms the Swiss National Park is a tract of country that is rigidly preserved. Its fauna and flora are subjected to the minimum of interference on the part of man and for this reason afford many problems of special interest to the biologist. Under the auspices of the commission for the scientific investigation of the Swiss National Park, a series of quarto memoirs on researches undertaken in that area is being published. The sixth memoir in that series has recently come to hand and deals with the forest insects of the Park ("Les Insectes Forestiers du Parc National Suisse". Pp. 50 + 24 plates. Aarau: H. R. Sauerländer et Cie. 12 francs). Its author, Dr. Aug. Barbey, mentions that the circumstances in which these insects were studied were purely economic and were in connexion with the ravages they cause among the forest trees. The life-history, mode of life and economic status of the more important species of insects are described. Various stages in their life-cycle, their larval burrows in wood and bark and other phases of these insects are admirably portrayed in the series of plates that accompany this memoir. Their ecological relations are also dealt with whether they be destructive forms, parasites or predators.

Reduction of Chimney Emissions

THE Technical Committee appointed by the Electricity Commissioners in 1930 to consider the methods that should be taken to prevent the emission of soot, ash and grit from the chimneys of electric power stations has now published its report (London: H.M. Stationery Office, 5*s.*). A sub-committee made a thorough investigation, visiting many foreign stations which have adopted preventive measures. In 46 of the 111 British selected stations no grit extraction plant has yet been installed. The subcommittee regards grading by sieves as unsatisfactory, as it is impossible when the mesh is too small and untrustworthy for larger values. Particles below 20 microns (1 micron is a thousandth part of a millimetre) when discharged into an air stream are sufficiently diffused to avoid creating a nuisance. The only satisfactory way of testing the efficiency of dust extraction plant is to weigh the dust in unit volume of the gases at as high a point in the chimney as practicable. In Germany, where the power stations are generally larger than in Great Britain, electrostatic precipitation together with very high chimneys is favoured. The main conclusions arrived at by the Committee are that dust nuisance is avoidable with new stations, but the application of means for its prevention to all existing stations may not be practicable. There is an urgent need for standardisation of good methods of testing dust extraction plant. For pulverised fuel installations the electrostatic precipitator is the most suitable type to use. Water for dust extraction is not to be commended. The minimum height of chimneys should be at least two and a half times that of the highest point of the generator station buildings. Photographs are given of the filters used for separating ash and grit particles and of plant for multiple-cyclone dust extraction.

Gaseous Tubes for Lighting

THE study of the discharge of electricity through gases has led to many important practical developments, the latest being the invention of vacuum tubes for lighting. If discharge tubes are filled to the same gaseous pressure with different gases such as helium, neon, argon, hydrogen and nitrogen, it is found that a certain definite voltage must be applied to the terminals of the tube before luminous effects are produced. This voltage depends on the nature of the gas and the pressure in the tube. In general, neon produces a luminous effect at lower voltages than the other gases and then comes helium. In some cases a mixture of gases becomes luminous at a lower voltage than any of the pure gases forming it. In a lecture to the Preston Scientific Society given on December 2, 1932, J. N. Addington gave an interesting account of the progress made in developing gaseous tubes for lighting and signalling purposes. In an Osglim lamp, which takes only a small fraction of the power taken by a filament lamp, the electrodes are of nickel or iron placed about 2 mm. apart and the neon gas filling has a definite low pressure. At 160 volts the lamp becomes luminous. These lamps operate from alternating current mains. Neon valves which operate traffic signal devices have now been developed at the Preston lamp works of Messrs. Siemens Brothers and Co. The red neon signs which are now familiar to all dwellers in cities have iron or nickel electrodes and the illumination is produced from the positive column. The intensity of illumination per unit area is relatively low in these lamps, which are called cold cathode tubes. In 'hot cathode tubes' currents nearly a hundred times as great can be obtained. The electrodes are coated with mixtures of alkaline earths and have a very high electronic emission when heated to 1,200° C. The use of metallic vapours like sodium, cadmium and magnesium has still further increased the efficiency of these tubes, but the colours at present obtained leave much to be desired when compared with daylight.

Gifts to Science

SIR DUGALD CLERK, who died on November 12 (see NATURE of December 24, p. 953), bequeathed £3,000 to the Institution of Civil Engineers; £2,000 to the Royal Society; £1,000 to the Royal Institution; £1,000 to the Royal Society of Arts; £1,000 to the Institution of Mechanical Engineers; £1,000 to the University of Glasgow; £1,000 to the University of Leeds; £1,000 to the University of St. Andrews; £1,000 to the University of Manchester; £1,000 to the University of Liverpool. The residue of the property is to be divided into thirty-one parts; three of these parts are to go to the Institution of Civil Engineers; two to the Royal Society; one to the Royal Institution; one to the Royal Society of Arts; one to the Institution of Mechanical Engineers; and one each to the Universities of Glasgow, Leeds, St. Andrews, Manchester, and Liverpool.

Entomological Society of London

THE Entomological Society of London will celebrate its hundredth anniversary on May 3, and a preliminary programme of the centenary celebrations on May 3-4 has recently been published. On May 3, a general meeting will be held in the rooms of the Royal Geographical Society at 3 P.M. and a scientific conversazione at 8.30 P.M. A reception has been arranged for May 4 at 9.30 P.M. This will be held at Lancaster House, St. James's, S.W.1, when the Right Hon. Walter Elliot, Minister of Agriculture and Fisheries, will receive the guests. Further information can be obtained from the Secretary, 41 Queen's Gate, London, S.W.7.

Chadwick Public Lectures

THE next series of Chadwick Public Lectures begins on February 21, with a discourse on "The Hippocratic Tradition" by Dr. Matthew B. Ray. The lecture will be given in the hall of the Royal Society of Tropical Medicine, 26 Portland Place, W.1, at 5.15. The second lecture will be given by Dr. E. Killick Millard on "Housing", on March 9 at 8 P.M. at the Royal Sanitary Institute. How to secure a pure milk supply is the question chosen by Dr. J. Walter Carr, for his lecture—"Cows' Milk" in March at the Royal Society of Tropical Medicine. In it, he will discuss the relative benefits of human and bovine milk for infants, the value of milk in adult life and how to render cows' milk a safe food. In May, Mr. P. W. Coombe will lecture on "Port of London Sanitary Administration". The actual processes and details of the organisation and maintenance of port and river hygiene will be discussed. Another lecture projected for May will be on the "Preservation of Health in the Navy" by Vice-Admiral Bond, and early in June the annual open-air lecture in the Chelsea Physic Garden will be given by Prof. J. G. Hill, on "The Green Leaf". Further information concerning these and other Chadwick public lectures can be obtained from the Secretary, The Trust Office, 204 Abbey House, Westminster, S.W.1.

Climate of Hong-Kong

COL. E. GOLD points out that, in the article entitled "Climate of Hong-Kong" (NATURE, Jan. 21, p. 104) the statement "much of it [mist and fog] is due to dynamical cooling of advancing damp southerly winds" requires amplification. Damp air moving from the south and rising to the higher levels of Hong-Kong about 1,500 ft. above the level of the Observatory and 1,600 ft. above sea-level is cooled by expansion as it rises and so causes much of the fog and mist at these higher levels. The fog and mist at sea-level, when it occurs with a warm southerly current of air, is due to the cooling of this current by the surface of the sea — or the surface of the land.

Announcements

THE Council of the Iron and Steel Institute has awarded the Bessemer gold medal for 1933, to Dr. W. H. Hatfield, director of research in the firm of Messrs. Thos. Firth and John Brown, Ltd., in recognition of his distinguished services in the advancement of metallurgical science, and of his valuable researches in connexion therewith.

HIS MAJESTY THE KING has approved the award of the Royal gold medal of the Royal Institute of British Architects to Sir Charles Peers, president of the Society of Antiquaries and chief inspector of ancient monuments and historic buildings, in recognition of his distinguished services to architecture and archæology.

THE annual May lecture of the Institute of Metals will be delivered on May 10 by M. Albert M. Portevin. The subject of the lecture will be "Quenching and Tempering Phenomena in Alloys". It is also announced that the silver jubilee meeting of the Institute will be held at Birmingham on September 18–21.

THE Sir Henry Trueman Wood memorial lecture of the Royal Society of Arts will be delivered on February 22, by *Sir William B. Hardy*, director of food investigation, Department of Scientific and Industrial Research, who will take as his subject "Industrial Research with Biological Material".

IT is announced in *Science* that F. Trubee Davison, Assistant Secretary of War in charge of aeronautics, has been elected president of the American Museum of Natural History to succeed Prof. Henry Fairfield Osborn. Prof. Osborn, who has been president of the Museum for twenty-five years, has been elected honorary president.

AT a meeting of the International Congress of Americanists in La Plata in December last it was resolved that the next meeting of the Congress, which, under the statutes, must be held in Europe in 1934, should take place in Spain. It was decided that an invitation to hold the Congress in Seville be accepted.

AT the annual meeting of the Royal Astronomical Society held on February 10, the following officers were elected: *President:* Prof. F. J. M. Stratton; *Vice-Presidents:* Sir Arthur S. Eddington, Mr. John Evershed, Dr. H. Knox-Shaw, and Dr. W. J. S. Lockyer; *Treasurer:* Mr. J. H. Reynolds; *Secretaries:* Mr. W. M. H. Greaves and Dr. W. M. Smart; *Foreign Secretary:* Prof. Alfred Fowler.

THE annual meeting of the Association of Technical Institutions will be held at the Cordwainers' Hall, Cannon Street, London, E.C.4, on February 24–25, under the presidency of Sir Hugo Hirst. Several papers of technical interest will be read at the meeting and a discussion on "Policy in Technical Education" will be opened by Dr. Percival Sharp and summarised by Principal J. C. Smail. Further information can be obtained from the Secretary, Association of Technical Institutions, Loughborough College, Loughborough, Leicestershire.

A GENERAL discussion on "Liquid Crystals and Anisotropic Melts" has been arranged by the Faraday Society and will be held at the Royal Institution, Albemarle Street, London, W.1, on April 24 and 25. The introductory paper will be given by Prof. C. W. Oseen (Uppsala). The following foreign visitors will contribute papers: Prof. L. S. Ornstein and Dr. W. Kast (Utrecht), Prof. V. Freedericksz (Leningrad), Prof. M. Jezewski (Cracow), Prof. G. van Iterson (Delft), Prof. D. Vorlander (Halle-on-Saale), Prof. H. Zocher (Prague), Prof. K. Hermann (Berlin-Charlottenburg), Prof. T. Rinne (Freiburg i. Br.), Prof. G. Foëx (Strasbourg), Prof. G. Stewart (Iowa), and Prof. J. J. Trillat (Paris). Prof. Hermann Mark (Vienna) and Dr. E. Friedel (Strasbourg) also hope to attend the discussion. The meeting is open to non-members.

A SERIES of eight lectures and demonstrations on tropical hygiene, which are intended for men and women outside the medical profession proceeding to the tropics, will be given by Lieut.-Col. G. E. F. Stammers at the London School of Hygiene and Tropical Medicine on March 6–15. This course, in addition to providing simple rules for guidance in regard to personal hygiene and preparation for life in the tropics, will also embrace a short account of some of the more common diseases, with advice in regard to measures of protection and self-treatment. Further particulars can be obtained from the Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in engineering at the University of Manchester—The Registrar (March 1). A staff lecturer and demonstrator (woman) in the Department of Chemistry at the Royal Holloway College, Englefield Green, Surrey—The Principal (March 15).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Electron Diffraction by Films of Grease

IN the course of some experiments on the diffraction of electrons by thin films of spluttered platinum, a curious pattern of straight lines with a few diffuse spots (see Fig. 1) was observed by one of us, quite unlike the usual circles of a Debye-Scherrer pattern.

Further investigation has recently shown that it was due to the accidental presence of a layer of tap grease on the specimen. A number of waxes and greases give similar effects when smeared on to a solid and used to reflect a beam of electrons.

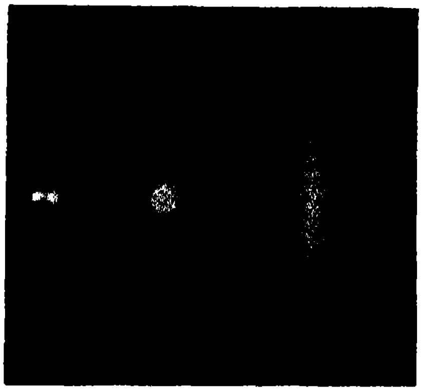

FIG. 1.

The patterns observed can be explained by supposing that the diffracting atoms occur in regular layers parallel to the surface, the layers being equally spaced, but the atoms in each layer being almost at random. Such a distribution would be produced by long-chain molecules normal, or equally inclined, to the surface, like those studied by N. K. Adam. The successive layers are the planes through successive carbon atoms of the chain. It will be noticed that alternate lines are darker than the others; this may be due to the zig-zag nature of the carbon chains which makes alternate atoms different from their neighbours. The spacing corresponding to the distance between a weak and strong line is 2·54 A. which agrees well with Müller's value of 2·537 A. for the distance between alternate carbon atoms.

Sometimes spots appear on the lines. These can be explained as due to a quasi-regularity of arrangement of the chains such as would occur if they were closely packed together.

The distance apart calculated on this assumption agrees fairly well with the cross section found by Müller.

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Jan. 25.

Convention and Fact

THE work of electrical commissions was one of the first, and remains one of the most successful, examples of international co-operation. The main reason for their success, where so many analogous bodies have failed, is that they confined themselves strictly to the establishment of conventions concerning matters (such as units and symbols) to which conventions are appropriate. Dr. Ezer Griffiths's article in NATURE of December 31, p. 987, shows that the International Union of Pure and Applied Physics does not intend to be bound by any such limitation. Although the title of his article suggests that its inquiries concern only units, it is plain that the Union proposes to discuss, if not to decide, matters of an entirely different nature, to which the conceptions of truth and error are applicable. This new policy demands far more attention than he has given to it.

Dr. Griffiths's second issue does, indeed, involve a matter of pure convention. It is agreed that there are at least two distinguishable magnitudes to which the name *permeability* and the symbol μ have been attached by various writers in the past. Everyone would welcome a decision to which of these magnitudes the name and the symbol are to be confined in the future, and a suggestion for the name and the symbol to be used for the others. But Dr. Griffiths, in stating this issue, asserts by implication two propositions that are not universally accepted and the validity of which is not a matter of convention. They are (1) that every quantity either has dimensions in length, mass and time or is a pure number, (2) that quantities not of the same kind have different dimensions. If it decided that these propositions were true or false, the Union would go far outside the sphere to which its predecessors have confined themselves. But I will not insist greatly on this matter, because it is not clear that the Union is really proposing to make such a decision; the propositions may have been introduced without authority by Dr. Griffiths in an attempt to state the issue concisely.

But there is no doubt of this kind about the first issue. The Union most certainly is trying to establish "a basis on which a connected account of electromagnetic phenomena should rest". For what purpose is this connected account required? Is it education, the statement of a logically complete theory, the formulation of 'consistent' units, or the experimental identification of the units formulated? Is it certain that a single connected account will serve adequately each and all of these purposes? Must the lecturer in electrical engineering work to the same syllabus as his colleague who is instructing mathematicians; and are the Diracs and Eddingtons of the future (or even of the present) to be forbidden to choose a 'starting point' for a theory of the universe inappropriate to immature minds? And what is a connected account? An answer to that question can only be based on some view of the logical structure of science, of the relation between fact and theory and between experiment and calculation. It must involve a choice between the views of this difficult matter taken by (say) Jeffreys, Reichenbach and Bridgman; none of these writers could possibly accept a connected account drawn up by another.

I submit that an International Union can do nothing but harm in even discussing questions that require a decision on such matters. An authoritative committee is the right body to establish a convention, because in conventional matters agreement is more important than any kind of truth. Of course there may be differences of opinion as to which convention is best; but the establishment of a convention does not require the acceptance of the committee's views on this point. A convention might be defined as something that a reasonable and conscientious man can accept and support loyally, although he believes that it is the worst of all possible alternatives. But where truth is more important than agreement, a committee can achieve nothing. If agreement actually exists, its pronouncements are superfluous; if it does not exist, a pronouncement, however authoritative, will not bring it into being. In spite of the increasing weight of authority in the realms of politics and religion, most scientific workers would surely still not deny that even an International Union may sometimes be unable to arrive at the truth.

It will be replied, I suppose, that the Union does not pretend to decide any of these questions, and that it is merely collecting the best opinion concerning them. If that is so, what does Dr. Griffiths mean by saying: "The British view is that . . ."? The discussion of the British National Committee apparently took exactly the course that might have been anticipated. Those who were known to have definite views on these matters each brought forth his 'King Charles's head' and said exactly what was expected of him. Those who had not thought about them deeply before offered opinions that really could not stand any serious argument. The publication of the whole discussion might possibly serve some useful purpose; but the selection from it of a "British view", formulated without argument, can lead to nothing but disaster. It is quite certain that the "views" of some other nations, formulated in the same manner, will differ from the British view; only two consequences can then follow. A fictitious agreement will be reached which will involve the public profession by some members of the Union of views on scientific questions that they do not really believe; or no agreement will be reached, and the cause of international co-operation will receive another setback from the failure of yet another conference—and all because the leaders of the scientific world cannot distinguish between convention and truth!

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Components of the Atmosphere and Synthetic Gases in Relation to Animal Life

IT was found several years ago in our experiments that small animals such as rats, pigeons, cats, guinea pigs, monkeys, etc., can live in a medium of air under control, but cannot live in pure oxygen under similar conditions, but will die within two to five days[1].

With a synthetic mixture of 79 per cent nitrogen and 21 per cent oxygen leaving out the 1 per cent rare gases such as argon, helium, neon, krypton, and carbon dioxide, it was found that the animals (white mice) would die within ten days to three weeks. The experiments were repeated ten times. These experiments led to the conclusion that the rare gases are vital to the normal respiration of life. By varying the percentage of oxygen from 25 to 60 with nitrogen the animals were under control from ten days to three weeks without any signs of ailments. In a number of cases it was found that synthetic atmospheres could be prepared that supported life in white mice more effectively than the normal air that we breathe every day.

For different gases alone it was found in a series of experiments that animal life would cease after two to five days in pure oxygen; in pure hydrogen, 36 minutes; in nitrogen, 6 minutes; in argon, 3 minutes; in neon, 1 minute and 40 seconds; in helium, 2 minutes and 40 seconds; in nitrous oxide, 10 minutes; and in carbon dioxide, 55 seconds.

By using 79 per cent helium instead of nitrogen and 21 per cent oxygen, an atmosphere is formed in which animal life will exist normally, or in some cases, apparently better than in a normal atmosphere. By varying the percentage of helium from 79 to 50 with oxygen the animals in every case appeared to be normal or better than in our natural atmosphere.

By using 0·03 per cent carbon dioxide, the amount that is normally present in the atmosphere, with 99·97 per cent of oxygen, the average time of life was found to be about the same as with pure oxygen. With a synthetic mixture of 1 per cent carbon dioxide and 99 per cent oxygen the average time of life was 3 days and 9·8 hours. With 5 per cent carbon dioxide and 95 per cent oxygen the average time of life was 4 days and 10·7 hours; with 10 per cent carbon dioxide and 90 per cent oxygen 2 days and 4·2 hours. The optimum mixture seems to be approximately a mixture of 5 per cent carbon dioxide and 95 per cent oxygen.

The chief principle of this therapy is that of using a mixture of oxygen and carbon dioxide. Carbon dioxide is used to stimulate the respiratory mechanism to full deep breathing, to flush and flood the blood in the lungs with oxygen, and to ventilate out of the blood any volatile toxic substance. To combat respiratory failure in this way is to use Nature's own agency to assist Nature towards recovery. Acapnia or deficiency of carbon dioxide in the blood and tissues, is a condition closely related to asphyxia or deficiency of oxygen in the tissues. Either of these deficiencies disturbs the respiratory processes of the tissues, and each involves a considerable degree of the other. Experimentally, a slight degree of acapnia may be induced by over-ventilation of the lungs. Inhalation of carbon dioxide affects a restoration of the alkali bicarbonates and carbon dioxide content of the blood.

Inhalation of carbon dioxide, by counteracting acapnia and inducing deeper breathing, inflates the lungs and prevents the development of pulmonary collapse (atelectasis). It is thus a specific preventive of the post-operative pulmonary complications that lead to pneumonia.

With all of the synthetic atmospheres experimented upon with animals, oxygen was always found to be necessary as one of the gases, but with oxygen alone, the animals would die.

This is really only one phase of the work that might be investigated. It would be desirable to have some other criteria than life as a test, for example, rate of growth, metabolism, activity, why the animals die in oxygen, etc.

In the field of practical applications of synthetic atmospheres there is a wide range of commercial uses and values. In deep sea diving, mines, and submarines, foul air is encountered and there is often a lack of sufficient pure air to sustain life. Aeronauts may carry a supply of prepared atmosphere aloft with them, and it may be provided for large factory and office buildings with more satisfactory results than when natural air from outside is used.

As suggested by Dr. Edward Fidlar[2] the chemist and physicist understand very little the rare gases in relation to animal life. The use of the oxygen tent in the treatment of pneumonia is a well established medical practice to-day. Other diseases may yield to a helium and argon tent. The widest field probably will be in pathological applications. Research work is just beginning in this direction.

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[1] NATURE, **122**, 684, Nov. 3, 1928.

[2] *Science*, **62**, 296, No. 1864; 1930.

Infra-Red Absorption Spectrum of Nitrogen Dioxide

THE infra-red absorption spectrum of the equilibrium mixture of NO_2 and N_2O_4 was investigated in the region of comparatively short wave-lengths by Warburg and Leithäuser in 1907 and 1909, and again in 1910 and 1913 by von Bahr. Preliminary experiments on the spectrum of nitrosyl chloride indicated N_2O_4 as a troublesome impurity, and it was decided to repeat the earlier work and to extend the observations as far as 18μ.

At room temperature a complicated spectrum with bands at 15·6, 13·4, 7·92, 6·17, 5·75, 3·22, and 2·91μ is obtained. The absorption tube was then placed between the source of radiation and the spectrometer, and heated to 100° C.; the maximum of radiation emission characteristic of this temperature is beyond 20μ, and it was found with this arrangement that disturbances of the thermopile due to fluctuations of temperature in the absorption tube were avoided. The interesting observation was made that all the bands disappeared with the exception of those at 15·6 and 6·17μ, the two latter remaining with undiminished intensity, and having a doublet structure with a separation of 35 $cm.^{-1}$ and 32 $cm.^{-1}$ respectively. They may accordingly be ascribed to NO_2, and the simplicity of the spectrum renders it highly probable that the molecule is rectilinear and symmetrical. The N–O force constant is approximately 7×10^5 dynes per cm., the deformation force constant being some 6×10^{-12} dyne cm., and the calculated moment of inertia is 66×10^{-40} $gm.cm.^2$, with an interatomic separation of 1·1 A. If ν_3 is 6·17μ, and ν_2 is 15·6μ, then the position of the inactive fundamental ν_1 may be calculated as approximately 11·1μ.

Further confirmation of the suggested structure may be obtained in a very neat way. The determined force constant for NO_2 corresponds to a single bond between each oxygen and the central nitrogen atom. If one more electron is available as in the case of the ion $[NO_2]^-$, the previously odd electron takes part in bond formation and we should have double bonds between the central and each external atom, with a corresponding elevation of the force constant to 14×10^5 dynes per cm., and, if the ion preserves the rectilinear structure, the Raman spectrum of the solution of an inorganic nitrite should provide a strong line with a separation giving the frequency of the inactive fundamental. Making the allowance for the difference in the force constants, we can calculate the approximate position of this line as 1328 $cm.^{-1}$, and experimental results show that aqueous solutions of inorganic nitrites have in fact an intense line at 1303 $cm.^{-1}$, the corresponding force constant being 14×10^5 dynes per cm.

Consideration of the manner in which given numbers of electrons available for bond formation may be allotted to definite electronic molecular proper-functions shows that in the case of $[NO_2]^-$, which has eight such electrons, it is probable that alternative states with near-lying energy levels are possible, and that reversion from the rectilinear structure characteristic of the ion in aqueous solution to an isosceles triangular form with a vertical angle of some 120° is rendered easy: the latter seems to be the structure of the ion in the crystalline nitrites.

Finally, where, by the establishment of a covalent link as in the case of the nitro- group, only six electrons are available for binding the atomic centres, the triangular form as above with the obtuse vertical angle (we may call this the SO_2 structure) is obligatory: and Dadieu and Kohlrausch from the results of Raman measurements find that the force constant for the NO link in $:NO_2$ is 9×10^5 dynes per cm. and the angle ONO is approximately 110°. As regards N_2O_4, the structure is probably best represented by Hendricks's suggestion of two plane nitro-groups at right angles to each other.

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Jan. 11.

Unusual Occurrence of Pelagic Organisms

IN NATURE of October 29, 1932, there appeared a letter from Messrs. Russell and Kemp, describing how large numbers of *Velella* and *Ianthina* had been cast up in the late summer, on the shores of Cornwall and south-west Ireland, and commenting upon the causes that might have led to this unusual abundance of planktonic organisms rarely present in the locality described.

It is very curious that far away here in New South Wales, we might have written an exactly similar letter about six weeks ago. Four miles off this coast on one rather calm day, I sailed through literally millions of large *Physalia*, *Velella* and *Ianthina*, and my crew were so intrigued at the sight that they proceeded to catch the *Velella* in cups and jars, whilst endeavouring to escape contact with the dreaded Portuguese man-of-war—not at all an easy matter. The invasion of these pelagic species lasted a fortnight or so, and was so great that the dried bladders of *Physalia* and *Velella* and the blue shells of *Ianthina* strewed the ocean beaches over a stretch of many miles.

It will be noticed that our season was springtime, the English season was summer, but the dates (August in England and October here) not so far apart. Presumably, the explanation of these two unusual occurrences at about the same time (it is years since such an invasion was noted here), is merely coincidence. It is difficult to regard it otherwise, seeing that we are in the Southern Pacific and the British swarms came from the North Atlantic. One *might* wonder whether some peculiar cycle of circumstances had led to an unusual development of the organisms in question in tropical ocean waters, like the numeral fluctuations so well known in more confined terrestrial species. But it is difficult then to account for a simultaneous abundance in species so far removed zoologically as *Physalia* and *Ianthina*.

Perhaps, therefore, we had better assume that the happening is just coincidence due to a like sequence of meteorological conditions in the two regions concerned.

Our Government Meteorologist has very kindly given me a comparison of the winds prevailing off this coast during the past three months with the average of eighteen years. From this, it would appear that sea breezes (winds with an easterly component) were not only more frequent than usual, but also the velocities were greater. Since a tropical current passes southward along the coast of New South Wales, it seems reasonable to suggest that a greater tendency for an easterly surface drift has brought shorewards organisms which are only infrequently stranded in such numbers.

It would be interesting to know whether any similar conditions were noted elsewhere during the year 1932.

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Dec. 14.

RECENT letters by Dr. Kemp and Mr. F. S. Russell[1] and Mr. A. C. Stephen[2] have directed attention to the occurrence of Atlantic organisms on the coasts of Great Britain and Ireland. It may be of interest to add another example to the list. While the Fishery Cruiser *Muirchu* of the Department of Lands and Fisheries was engaged in taking physical observations off the south-west coast of Ireland, fifty miles south-south-west of Fastnet Light, on August 9, 1932, considerable numbers of a large salp, 3-8 cm. long, were noticed drifting a few feet below the surface and some were captured. These proved to be the sexual stage of *Cyclosalpa bakeri*, Ritter. Several other specimens occurred in a tow-netting taken on the same station, and also in another taken seventy miles south-south-west of the Fastnet, suggesting that the shoal may have been twenty miles across. *Cyclosalpa bakeri* appears to be mainly a tropical species and I do not know of any previous record from British or Irish waters.

Another possible indication of abnormal conditions in 1932 was the unusual number of blue sharks (*Carcharias glaucus*) noticed during the same cruise along the south coast of Ireland. Frequently, when the ship was stationary, two or three might be seen swimming round and devouring the offal thrown to them.

Velella was not noted during the cruise in any unusual numbers. A few, living, were seen about thirty-five miles north of Horn Head, Co. Donegal, a few, dead, seventy miles south-south-west of the Fastnet and one, living, thirty miles south of Ballycottin, Co. Cork. It seems probable, judging both from recorded observations and reports received from lay sources which cannot always be verified, that *Velella*, and possibly also *Ianthina*, occurs almost every year off the west coast of Ireland, but it is only when they are drifted shorewards by a favourable wind in unusually large numbers that attention is directed to them.

The assumption is sometimes made that the presence of Atlantic organisms is an indication of an abnormal influx of Atlantic water, and their absence of a contrary condition, but such an inference ought to be received with caution unless supported by hydrographic records. Possibly the abnormality lies in the occurrence of conditions exceptionally favourable to the development of the organisms in some distant locality whence the Atlantic drift is derived, rather than in any acceleration of the drift or recognisable increase in the salinity or temperature of the water impinging on our coasts.

G. P. FARRAN.

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Dublin.
Jan. 23.

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[1] NATURE, 130, 664, Oct. 29, 1932.
[2] NATURE, 130, 889, Dec. 10, 1932.

Sexual Reproduction in Copepods

AMONG the lower groups of Crustacea, namely, the phyllopods, cladocera and ostracods, parthenogenesis is a well-known phenomenon and in many cases it is the only one known by which reproduction takes place. It is therefore remarkable that the process has only been recorded once within the free-swimming copepods[1].

Now copepods are probably better known than any other group of Entomostraca, and within it one division at least, the genus *Cyclops*, is remarkable for the cosmopolitan distribution of many of its species. Since resting eggs, which can be hatched from dried mud, and parthenogenesis go so naturally together among the Cladocera and ostracods, one might reasonably expect *Cyclops* to possess both these properties. This would be the simplest way of accounting for this world-wide distribution of the species. A natural conclusion is that parthenogenesis really does occur among copepods but for some reason it has been overlooked, and a considerable amount of evidence should be forthcoming before one can deny its existence.

During the last ten years, breeding experiments have been carried out almost continuously with different species of *Cyclops* at Marlborough, and although parthenogenesis has been sought time after time, it has never been found. The most obvious experiment is that of obtaining a brood of nauplii and separating each at an early stage and rearing them to maturity. This has now been done with several species and in no case has a single female produced living offspring. Eggsacs may be produced, and they nearly always are, but they simply drop off in time and the eggs decompose. On one occasion on looking at my cultures for the last time on the last night of term, I found three female specimens of *Leptocyclops agilis* each with a perfectly normal pair of eggsacs. I was obliged to motor the next day to a place in Sussex, just 150 miles away, but managed to return the same night hoping to see living nauplii. These were not there, but in each case the eggsacs had just fallen off and were lying at the bottom of the vessel where they gradually decomposed.

Yet further evidence is obtainable from direct experiment. A male is placed with a number of adult females which have been isolated from birth, and the male is left with them for a limited period and then removed. In these circumstances it is usual to find that more than one female gives rise to living offspring, and the female may produce as many as three broods of nauplii, but she will cease to function unless coition is again allowed to take place.

From this it seems safe to conclude that in many species of *Cyclops* parthenogenesis has not escaped notice. It does not occur.

A. G. LOWNDES.

[1] Roy, J., "Sur l'existence de la parthénogènese chez une espèce de Copépodes (Elaphoidella bidens)." *C.R. Acad. Sci.*, **192**, 558–575; 1931.

Abnormal Movability of the Heart

IT has been found that 9 per cent of 124 healthy soldiers and 26 per cent of 53 healthy high-school girls possess abnormally movable hearts. The criterion of movability taken was the displacement of heart apex due to change of body posture from standing to right lateral positions plus the displacement due to change from standing to left lateral positions. Frequency distribution as regards the movability is shown in the following table:

Movability in cm.	Frequency	Remarks
1 and 1·5	1	Normal heart.
2 2·5	133	
3 3·5	18	
4 4·5	0	
5 5·5	0	
6 6·5	0	
7 7·5	5	Cor mobile.
8 8·5	6	
9 9·5	6	
10 10·5	3	
11 11·5	3	
12 12·5	2	
13 and more	0	

To this distinctly separated group of abnormal movability of heart, I propose to refer by the term 'cor mobile', although this expression has been assigned to some rare cases of abnormal movability of heart of rather indefinite nature.

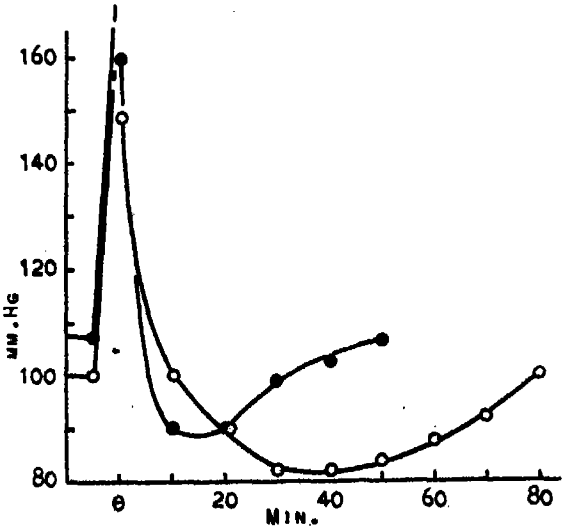

FIG. 1.—Effect on blood pressure by running 100 m. in two cases of 'cor mobile'.

It is interesting to note that the 'cor mobile' individual is liable to show a subnormal phase of blood pressure after strenuous exercise. A group of 14 normal soldiers and another of 14 soldiers with 'cor mobile' were taken at random. After running 100 metres, they were submitted to frequent observations of blood pressure. The result was that 6 out of 14 (43 per cent) normal soldiers showed a more or less marked subnormal phase, while all the 14 'cor mobile' subjects gave a marked, often conspicuous one (Fig. 1). In view of these findings we should like to direct the attention of investigators of the subnormal phase to the fact that the results of experiments may be expected to vary according to the number of subjects possessing 'cor mobile'.

Röntgen photographs of 'cor mobile' are being reproduced elsewhere.

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Dec. 20.

'Raw' Weather

REFERRING to Mr. Beckett's letter in NATURE of January 28, p. 132, by cold moist air I meant air which *feels* moist, and contains particles of water whether visible or invisible. For equal volumes, water has some 3,000 times the thermal capacity and 200 times the conductivity of air. To convert 1 gm. of water at skin temperature into vapour about 600 calories of heat must be supplied. Thus we see how particles of cold mist cool down the skin surface where they touch, and produce the sensation of cold.

Mist and cloud also cut off the radiant heat of the sun. A piece of black fur may be warmed by the summer sun 30° C. more than the air. I found that a coat hung out for four hours in a mist gained 3½ oz. in weight. The water in such damp clothes must be so evaporated by body heat. Thus, as Mr. Beckett says, clothes come into the question. Wet ground is cooled by evaporation, and is not warmed by the sun; and the wind blowing over it is chilly, and entering houses through chinks and crannies may increase the damp of the walls and contents. The cooling power of wind exerted on the body, as shown by the katathermometer, may be very great. Thus a man lying in bed may feel the change of weather

There is, I think, no convincing proof that ionisation or de-ionisation of air such as occurs in ordinary rooms, or out of doors, has any physiological effect. On the other hand, there is abundant evidence that exposure to cold and certain radiations affect the feeling and produce reflex effects on the deeper organs.

Referring to Prof. Russ's letter in the same issue of NATURE, changes of barometric pressure which affect the body equally all over have no mechanical effect upon it. I have observed men under a pressure of even ten atmospheres, and other men, given oxygen to breathe, submitted to a pressure reduced to 170 mm., and no sign of discomfort. Prof. J. Barcroft and his co-workers, however, found that climbing at a pressure of 170 mm. produced pain in the joints, and this in spite of breathing oxygen. The pains, probably, were such as those felt by an athlete after a race, and were due to a local oxygen want. In the case of the athlete, they may be set aside by breathing oxygen before and after the race. At 170 mm., even the breathing of oxygen does not secure a supply sufficient for hard work.

It is probably that local changes of the circulation brought about reflexly by cold, moving, moist air, and want of radiant heat, may produce pain in joints which are not normal, but exposed to some toxic agent the power of which is increased by a lessening of the oxygen supply. In those living a sedentary life, the circulation is very deficient in muscles and joints which are very little used.

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Distribution of the Polychæte Worm, *Syllis ramosa*, McIntosh

IT is generally admitted that one of the most remarkable forms of life discovered by the *Challenger* expedition is the polychæte worm, *Syllis ramosa*, in which the body branches laterally, these branches again sending off shoots into the passages of the sponge in which the worm lives. The result is an intricate net-work (except that, of course, the branches do not anastomose), and as each branch ends in an anus there is a large number of ani to one head. The two specimens obtained by the *Challenger* lived in the bases of hexactinellid sponges found at 140 fathoms depth in the Arafura Sea and in the Philippines at 95 fathoms.

Mr. C. C. A. Monro of the British Museum, in a letter to me, writes: "I have not searched the literature thoroughly but as far as I know, *Syllis ramosa* has not been seen since the 'Challenger' except off the Japanese coast, where it appears to be moderately common. It was found by Izuka in Sagami Bay in about 100 fms. and in Struga Bay in 90 fms., usually in a Hexactinellid sponge (*Crateromorpha meyeri rugosa*)."

Its appearance in the northern Red Sea at a depth of one fathom is therefore worth noting. I obtained it from a small sponge about 10 mm. in diameter which was attached to a dead branch of the coral *Lobophyllia corymbosa*, on the edge of a small coral reef about 100 yd. from the laboratory of the Biological Station of the University of Egypt, at Ghardaqa (known to the oil companies, and marked on some maps, as "Hurghada"), just south of the entrance to the Gulf of Suez.

The method of its discovery is also worth describing, as it is the only way in which the bulk of the smaller fauna inhabiting any material can be obtained. A bucket full of the material, in this case, dead branches of *Lobophyllia*, is kept overnight in water to which a handful of magnesium sulphate is added as a narcotic. This causes burrowing and cranny-loving forms to emerge, and on going over the material, 12 to 24 hours later according to the temperature, these may be rinsed or picked off each piece of stone, shell, coral or wood. At the bottom of the bucket remains a considerable bulk of small life, principally Crustacea and Polychæta, with Mollusca, planarians, small echinoderms, sipunculids, etc. This can be washed in old spirit, decanted from sand, and bottled for future examination. As an indication of the difference which would have been made to the older collections had this method been used, I may mention the Staurocephalidæ, small and particularly beautiful Polychæta, which figure in about one collection in twenty. Here, and elsewhere, I have found them in one or two cases by ordinary collecting, but by 'washing out' I find them frequently in fair numbers. In the present case on finding in my 'washing' two small pieces of *Syllis ramosa*, I worked over the material again and soon found the little fragile siliceous sponge in which is the remainder of the worm. I have not attempted to dissect out the head and have not found any sexual buds, preferring to make a thorough search when I have more material. Of its specific identity with *Syllis ramosa*, I have no doubt.

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Jan. 24.

A Dodecapodous Pycnogonid

IN a letter published in NATURE for July 28, 1910, I directed attention to Prof. E. L. Bouvier's discovery of *Pentapycnon* and discussed its relation to the other two genera of decapodous Pycnogonida. I am now able to announce the even more surprising discovery of an antarctic pycnogonid with *six* pairs of legs.

A few days ago, Sir Douglas Mawson handed over the Pycnogonida obtained on his latest antarctic expedition to be worked out by my colleague, Dr. Isabella Gordon. Among these is a magnificent specimen spanning 19 inches from tip to tip of its outstretched legs. So far as our preliminary examination has gone, it appears to differ from the two species of Decolopoda in no important respect except that it has an additional pair of legs. Exact particulars of the locality where the specimen was taken are not yet available, but it was dredged at a depth of 219 metres in the region of the antarctic lying to the south of Australia.

Dr. Gordon and I propose to describe this remarkable new form in detail elsewhere and to discuss its bearing on the problems of pycnogonid phylogeny. It need only be said at present that it appears to offer no obstacle to the view, which I have previously advocated, that the decapodous (and now the dodecapodous) Pycnogonida have been derived from octopodous forms, and that the Pycnogonida as a whole may conceivably owe their origin to an analogous disturbance of the established metameric pattern of the normal Arachnida.

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Feb. 13.

The Second Piltdown Skull

IN his work on "The Skeletal Remains of Early Man" (Smithsonian Miscellaneous Collections, vol. 83, 1930), Dr. Aleš Hrdlička doubts my statement that the late Charles Dawson discovered the isolated lower molar tooth of *Eoanthropus* with the remains of the second skull in the Piltdown gravel. Fortunately, among old correspondence, I have just found a postcard of July 30, 1915, written by Mr. Dawson, in which he announces his discovery of this molar tooth "with the new series". I have given the postcard to the Geological Department of the British Museum (Natural History), so that the record may be preserved and made available for reference.

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Research Items

Eskimo Culture Sequence. Stratigraphical evidence from Point Barrow, Alaska, obtained by the latest Alaskan expedition of the Smithsonian Institution, Washington, D.C., would appear to have gone far towards establishing a sequence of Eskimo cultures and determining the place and character of the 'Thule' civilisation of the eastern Eskimo. Hitherto it has been impossible to investigate the oldest 'ivory' culture of Point Barrow by excavation, owing to the short period during which the waters are open; but Mr. James A. Ford, archæologist of the Smithsonian Institution, elected to stay in Alaska during the winter 1931-32, in order to begin digging in June last as soon as the ground thawed. By excavating the 'ivory' culture burials—the settlements have disappeared owing to land subsidence—and the later settlement-mounds, he found that the 'ivory' culture was immediately followed by the 'Birknirk' culture in the graves and that the 'Birknirk' culture was the oldest stratum in the settlement-sites. It was here followed by a transitional stage to the 'Thule' culture, which in turn was followed by a stage scarcely to be distinguished from present-day Eskimo. It is thus shown that not only is the 'Thule' culture to be derived from the ancient Eskimo, which had been doubted; but also that it is relatively recent, and not, as had been thought, of high antiquity. Now at St. Lawrence Island, the 'Birknirk' culture has been found as a variant sequel to the Old Bering Sea culture, the latter being more usually followed by the 'Punuk' culture, a simpler form, which in the course of many centuries degenerates into the crude art of the modern Eskimo. As Ford found both the Bering Sea culture and the 'Birknirk' stage in the Point Barrow graves, it would appear that here the folk were colonists from the Bering Sea population, especially as an outpost of the 'Punuk' was found as the oldest stage of a settlement about sixty miles from Point Barrow. The details of evidence, upon which the summary of conclusions recently issued by the Smithsonian Institution is based, will be published in full in due course.

The Copper Age in Ancient China. The existence of stone and bronze ages in China has been admitted with certainty but the existence of an intermediate copper age has been questioned. A copper age in Egypt has long been established and it would have been expected that it must have existed in ancient China. In the *Bulletin of the Chemical Society of Japan* (December, 1932), Tsurumatsu Dono has described the chemical analyses of three ancient spear heads which closely resemble the objects recently found on the Yin site in the Ho-Nan province. These contain no appreciable amount of tin, which was detected only by the spectroscope. One specimen was nearly pure copper, with about 3 per cent of lead, whilst two others were lead bronzes, with 22·4 and 26·8 per cent of lead, respectively. If these specimens belong to the Yin dynasty, the copper age existed in that period and was in transition to a bronze age, which passed into an iron age about the end of the Han dynasty. Although Dr. Dono does not refer to the fact, it is significant that these lead bronzes of ancient China are similar to those of Sumerian Mesopotamia, and this would seem to lend support to the suggestion made some time ago that a connexion existed between the Sumerian and ancient Chinese civilisations. Only one specimen contained arsenic, and that only 0·8 per cent, whereas the ancient Egyptian bronzes often contained appreciable amounts of arsenic. All three specimens contained 1–2 per cent of iron.

Vocational Guidance and Health. The *Human Factor*, vol. 6, No. 10, contains an article by Mr. Angus Macrae on "Vocational Guidance and the Health of the Industrial Worker". The writer reviews the rôle of the physician in industry and the whole field of vocational guidance. He urges that the physician should exert a constructive influence and make recommendations based on the examinee's physical capacity instead of merely giving negative advice occasioned by some physical deficiency. Most general practitioners make inadequate, if any, reference to the 'mental' condition of the patient. The recent development of the psychologist's technique and the admitted success of various tests make a clearer diagnosis possible. Mr. Macrae refers to most of the work of importance achieved along these lines, surveys the influence of various specific environmental conditions, and concludes with a plea for greater co-operation between the doctor, psychologist and school staffs. He also recommends guidance for leisure as well as work, a more detailed supervision of the juvenile worker and the extension of vocational advice to those already in industry. The comparatively new idea that the supervisor, no less than the worker, may be a misfit is also stressed.

Development of *Gyrocotyle*. Of 93 examples of *Chimæra monstrosa*, examined by J. S. Ruszkowski (*Bull. Internat. Acad. Polon.*, Sci. et Lettres, B.2 (1931), 1932) in the summer of 1927 and 1929 at the Biological Station at Herdla near Bergen, all but one contained in the spiral valve the unsegmented cestode, *Gyrocotyle urna*. The much convoluted uterus of these cestodes was filled with eggs so that abundant material for the study of the development was available. The egg, which is oval and operculate and contains the egg cell surrounded by numerous yolk cells, develops satisfactorily in sea-water in Petri dishes at laboratory temperature. By about the twelfth day the embryo exhibits feeble movements which gradually become more pronounced and ten crotchets appear at the end of the embryo away from the operculum. About a month after the eggs have been laid, the operculum is raised and the ciliated larva with its ten posterior crotchets escapes. It swims actively at first but its movements become slower and after a day almost cease; the larva can live for six days. Attempts to infect bivalve molluscs with the larvæ were negative. On examination of the contents of the intestine of *Chimæra* the author found four young worms 4–10 mm. long. The extremity of the worm with the sucker has been regarded by some authors as anterior, while others have held that the opposite extremity with the rosette is anterior. The crotchets appear at the end which later forms the rosette and this therefore ought to be regarded as the posterior end.

Trematodes of Marine Mammals. Emmett W. Price (*Proc. U.S. Nat. Mus.*, vol. 81, Art. 13, 1932) has brought together the descriptions of all trematodes recorded from marine mammals, has made emendations or additions to the previous descriptions of ten species, based on examination of specimens, and has described a new genus and two new species. He reports that a specimen from *Orcinus orca* (*Orca gladiator*) so closely resembles *Fasciola hepatica*, except in body size and in having a slightly smaller egg, that it must be referred to this species. *F. hepatica* has been recorded also from *Balænoptera acutorostrata*. The trematodes known from marine mammals comprise 31 valid species belonging to nine families. Keys are given to the families, genera and species, a list of hosts and their trematodes is appended and figures of all the species except one are provided on the twelve plates at the end of the paper.

Bacterial Detoxification. The historical and theoretical aspects of bacterial detoxification have recently been summarised by Robert S. Harris and John W. M. Bunker (*Proc. Amer. Acad. Arts and Sci.*, vol. 67, No. 5, p. 147, June, 1932). A list of the agents that have been found to be detoxifiers is given, with full bibliography. Most of these agents depress surface tension, but detoxification is not considered to be due to this depressant action alone, or to any particular anion or cation, but to the configuration of the molecule as a whole. One of the best detoxifying agents is sodium ricinoleate, and in suspension in a three per cent solution of this substance the *Staphylococcus aureus* does not produce abscess formation, or the tubercle bacillus infect, on inoculation into animals. This protective action against the bacteria is not due to germicidal action of the detoxifiers.

British Columbia Douglas Fir Timber. One of the difficulties which would-be users of Empire timbers, both conifers and hard-woods, have experienced has been due to the absence of grading in imported stocks. In connexion with soft-woods, it is held that the best hopes for a big market lie with British Columbian Douglas fir. The appearance of a small pamphlet (H.M. Stationery Office, 6*d*.), entitled "Empire Timbers for Structural Design. British Columbia Douglas Fir", from the Forest Products Research Laboratory at Princes Risborough, is particularly opportune. This pamphlet directs attention to the developments which have taken place in recent years in the grading of structural timbers in Canada. The closer selection of timber with reference to the occurrence of defects, both natural and accidental, leads to much economy through the use of smaller sizes and longer spans. Probably no other timber has of late received so much attention as Douglas fir, for its characteristics have been studied in the forest products laboratories of Canada and of the United States of America, and its application in industry has been systematically developed by several commercial associations. Special classifications of British Columbian timbers have been made to meet the market in Great Britain and quite recently new grades of Douglas fir have been standardised to meet its particular needs. Tables are included in the pamphlet giving safe loads for each of a number of sections supported on varying spans to assist those who wish to employ Douglas fir as joists or rafters in buildings.

Palæozoic Brachiopods. An important monograph by C. Schuchert and G. A. Cooper ("Brachiopod Genera of the Sub-Orders Orthoidea and Pentameroidea", *Mem. Peabody Mus. Nat. Hist.*, 4, 1, 1932) deals with two extinct groups which are found abundantly in Palæozoic deposits. The Orthoids are the most primitive forms of articulate brachiopods and are considered to contain the stock from which all other articulates have evolved. Thus the Pentameracea and Strophomenacea appear to have been derived from the Orthacea. The authors first give a detailed account of the morphology of the shell in the Orthoids and Pentameroids. The table defining briefly but clearly the numerous terms employed will be helpful to students, but it is to be regretted that the widely used term 'cardinal area' is replaced by 'interarea' and 'palintrope' (apparently synonymous). In the Orthoids and Pentameroids, 135 genera and sub-genera are now recognised. The main part of the work is devoted to the description of these genera and sub-genera, their distinguishing features, phylogeny and distribution, with a list of the American and European species which the authors can definitely assign to each genus. British palæontologists will be interested in the suggestion that the well-known genus *Stricklandia* belongs to the early Rhynchonellacea and not, as hitherto thought, to the Pentameracea. Another work on Palæozoic brachiopods, by C. O. Dunbar and G. E. Condra ("Brachiopoda of the Pennsylvanian System in Nebraska", Nebraska Geol. Surv., Bull. 5, ser. 2, 1932) deals with the Middle and Upper Carboniferous brachiopods of Nebraska but mainly from a faunal point of view.

Submarine Faulting in Kimmeridgian Times. Among the normal sediments of the Kimmeridgian coastal strip of the Helmsdale district of east Sutherland a series of boulder beds is interstratified, the origin of which has long been problematical. A careful redescription of the evidence has been given by Prof. E. B. Bailey and Dr. J. Weir (*Trans. Roy. Soc. Edinburgh*, vol. 57, 1932–33, pp. 429–67), and as a result of their investigation they have reached the conclusion that the beds in question are the result of submarine landslips, precipitated by earthquakes along the line of an adjacent fault, and distributed by tsunamis or tidal waves. The fault-scarp was maintained by intermittent movement of the sea-floor, the aggregate movement exceeding two thousand feet. The Old Red Sandstone exposed in the fault-scarp furnished boulders that exceptionally reached a length of a hundred feet. The scarp separated a comparatively shallow-water facies of rounded pebbles and sand, with brachiopods, sea-urchins, corals, etc., from a comparatively deep-water facies, characterised by mud, with debris of land plants, ammonites, etc. The effects of earthquakes are registered not only by the spreading out of the landslips into graded boulder beds, but also by fissuring of the Kimmeridgian and the production of breccia along the fault. The local movements are shown to be contemporaneous with other movements in Britain. The interpretation of the boulder beds is like that already put forward by Bailey, Collet and Field to account for the Palæozoic boulder beds near Quebec. Other analogues in Britain, Switzerland and the United States are briefly discussed. The paper is an important contribution to world geology as well as a model of geological description and interpretation.

Sources of Light for Interferometer Work. Such work as the determination of the metre in wave-lengths of light demands a source of light which is very homogeneous and capable of exact specification. The Michelson cadmium lamp has been generally used for this purpose, but its manipulation is inconvenient. Messrs. Rolt and Barrell, working at the National Physical Laboratory, have examined the suitability of a new type of lamp for such purposes. The lamp is made by the Osram laboratories in Germany and consists of an A.C. discharge between electron-emitting filaments in argon. Some cadmium is present in the tube and when the lamp is running steadily the cadmium spectrum alone is excited. The spectral lines were examined by a variable Faby-Perot etalon, and within the accuracy possible, which was limited by the temperature control of the latter, no difference could be established between the two lamps when the Osram lamp was run with the (reduced) current of 1 amp. With 2 amp. the blue and green lines showed increased complexity, which may be due to self reversal, and the red line itself showed some evidence of inhomogeneity. The authors intend to repeat the work with an invar mounted interferometer.

Gaseous Combustion at High Pressures. The January *Proceedings of the Royal Society* contains a series of papers on the part played by nitrogen in carbon monoxide and hydrogen combustions. In the experiments made by Bone, Newitt, and Townend, explosions of carbon monoxide-air and hydrogen-air mixtures were made in a wire-wound steel bomb under initial pressures of 500–1,000 atmospheres, and the explosion pressures were recorded continuously by a Petavel manometer. As in previous experiments at lower pressures, a liberation of heat was observed for some time after the explosion of a $CO-O_2-N_2$ mixture, which was ascribed to nitrogen molecules activated by the burning carbon monoxide. This effect reached a maximum for initial pressures of about 500 atmospheres. The explosions, both of hydrogen and carbon monoxide, were slightly slowed by the higher pressures, but a hydrogen-air mixture at 750 atmospheres detonated very violently. At the higher pressures, $CO-O_2$ mixtures containing carbon monoxide to replace the nitrogen of the air—carbon monoxide mixtures deposited some carbon on explosion, presumably because the high pressure favoured the reaction $2CO \rightarrow CO_2 + C$. In a paper by Newitt and Outridge, the formation of nitrogen oxides in $CO-O_2-N_2$ explosions was investigated. The products of explosion were liberated into an expansion chamber by the bursting of a steel disc; and the gases thus suddenly cooled were analysed at leisure. Considerable quantities of nitrogen oxides were found and their formation was greatly helped by raising the pressure. The yield of nitrogen oxides was greatest when the disc burst after the maximum pressure had been attained, and the authors explain the formation of the oxides as due mainly to activated nitrogen produced in the explosion. In the third set of experiments, by Newitt and Lamont, carbon monoxide flames were burnt steadily in oxygen-nitrogen mixtures. Nitrogen oxides were formed, particularly at high pressures. The oxide formation is again ascribed to activation of the hydrogen, the mere temperature of the flame being of comparatively small importance.

Astronomical Topics

Earth's Influence on Sunspots. Many solar observers have noted an apparent earth effect in studying the number of spots that are born or disappear in different regions of the visible disc. Mr. P. R. Chidambara Aiyar, of the Kodaikanal Observatory, has collected all the spots of duration two days observed at Greenwich from 1874 until 1930 (*Mon. Not. Roy. Astr. Soc.*, Dec.); they are 1,395 in number. When plotted, they show maxima near the east and west limbs, and also near the centre of the disc, with minima at the intermediate zones, both east and west. There is also a graph of the longitude of birth of spots of two-day duration, from the Kodaikanal records. This shows a similar arrangement, but the minima are not quite so deep; only 389 spots are available, so the weight is smaller. It is difficult to form any plausible hypothesis to explain the falling off in numbers at the intermediate zones.

Comets. An interesting photograph taken by Prof. van Biesbroeck at Yerkes on November 28 and reproduced in *Popular Astronomy* for January shows the two periodic comets Faye and Brooks within half a degree of each other; Faye is distinctly the brighter, but both are easily seen, and have short tails. Comet Geddes, discovered in New Zealand last June, when near the south pole, has now come north, and was seen at Yerkes on December 18, in spite of moonlight. Observations from Tashkent are also to hand. There is an ephemeris in the B.A.A. Handbook.

Prof. van Biesbroeck also reproduces a photograph taken on December 20 of the new comet Dodwell-Forbes; it was of magnitude 9½, 3′ in diameter, without a stellar nucleus or a tail. The period of nine years, given at first, is too short; it is probably a century or more. Mr. Forbes found this comet on December 15, which was probably before Mr. Dodwell saw it; but it was a public holiday in South Africa (Dingaan's Day) and that caused a delay in circulating the announcement.

The comet was seen in Devonshire with a 3 inch telescope, but is now fading.

Proper Motions in the Lund Zone of the Astronomische Gesellschaft Catalogue. Lund Meddelande, Ser. 2, No. 65, contains a discussion of the proper motions of the stars in this zone by W. Gyllenberg. This list, which is the second one published, contains 277 stars, the determination of their proper motions being made by a graphical method. In order to test the validity of the method, the proper motions of ninety-three stars were also investigated by a rigorous least-square method. This comparison revealed the fact that the graphical method introduced a systematic error which makes the proper motions determined by it numerically too large. An explanation of the discordance, based on the theory of errors, was found, and formulæ deduced for correcting the graphical proper motions. The error increases with the size of the proper motion and can be rendered small by doing the graphical process twice; in the second graph the observations are corrected for the approximate proper motion found by the first graph. The faintest stars in the catalogue are of magnitude 9·4; several of these faint stars have considerable proper motion. Incidentally, it was noted that much trouble would be saved by excluding the catalogues of Lalande and Bessel; these aimed at quantity rather than quality, and many of the positions in them are inexact.

Work of the Government Chemist

DECREASES in the number of samples examined during the year ended March 31, 1932, by the Government Laboratory at Clement's Inn Passage, at the Custom House branch, and at seaport chemical stations are, as is stated in the report of the Government Chemist (H.M. Stationery Office, 1932. 9*d*. net), a sign of the present state of industry generally. Nevertheless, the examination of nearly half a million samples, together with the research work continuously involved in the maintenance and increase of efficiency, form the substance of the report of a very active year's work.

The Government Laboratory, while providing various departments of the public service with analytical reports on samples submitted to it, and reporting on samples referred to it by magistrates under the Food and Drugs (Adulteration) Act, 1928, performs a considerable number of services of general interest and purely scientific value. Thus, sea-water samples are examined in connexion with a scheme of oceanographical research carried out by the Fisheries Department of the Ministry of Agriculture and Fisheries, and by the Fishery Board for Scotland, acting in concert with the International Council for the Exploration of the Sea. The objects of these investigations are to trace the influence of salinity on fish life, and to trace the movements of water, apart from tidal motion, from one part to another in the sea.

Attention has also been directed to the preservation of cinematograph films of national importance, and the development of such films is now being carried out under supervision and control. The Laboratory's advice was also sought with regard to the best method of preserving cinematograph films taken on the "Discovery" expedition. At the laboratory in the Geological Survey and Museum, complete analyses of fifteen rocks were made, and various other specimens were subjected to tests. Methods have been worked out in connexion with the analyses of igneous rocks, metamorphic rocks, and minerals, and the determination of alkalis in rocks has been studied with the view of increasing the accuracy of the results.

Reporting on the composition of imported cheese, the Government Chemist states that only 43 per cent of the samples had been prepared from whole milk, but remarks significantly: "As, however, there are no regulations relating to the marking of skimmed or partially-skimmed milk cheese, no exception could be taken to any of the importations." Similarly, most of the samples of cream contained only 19–35 per cent of fat, the group containing 45–55 per cent representing only 9 per cent of the total; but "since there is no standard for cream in this country, exception could not be taken to the samples in respect of low proportion of fat". Examples of investigations of industrial interest are quoted.

A sample of synthetic resin was examined for the Office of Works in respect of its suitability for varnishing pictures, but the material was rejected since it developed acidity with lapse of time. Various paints, oils, and thinners were investigated to discover the cause of the defective drying of paint applied to the walls of a building, and one of the fluids examined was found to contain nitrobenzene in quantity sufficient to inhibit the drying of the paint. An investigation for the Admiralty, at present in progress, is the search for a relation between the tendency of oilskins to become 'tacky' in humid climates and the nature and proportion of the driers present in the oil, and its treatment.

Many samples of cider were examined in connexion with a scheme for grading cider entitled to bear the National Mark; a commercial preparation recommended for preventing 'cider sickness' but not permitted for use in such cider was found to be a solution of phosphoric acid. During the year about 150 mgm. of partially purified radium was recovered from decayed luminous paint, and 242 milligrams of partially purified radium was converted into high-grade salt of 66 per cent purity.

For the Imperial War Museum ninety medals and plaques have been cleaned, restored, and lacquered for preservation, work which necessitated a preliminary investigation into the character of the corrosion product. The services of the Laboratory were also requisitioned in a number of cases of suspected fraudulent use of stamps and repayment claims.

Irish Woods and their Significance

THOSE who have endeavoured to study the past history of the forests of a country have quickly appreciated the great difficulties which present themselves. Assumed facts and widely held theories are discovered to be based on the slenderest evidence, and have afterwards been so often repeated in histories and so forth as to have become accepted as incontrovertible facts. Ireland presents a remarkable illustration. In the majority of histories dealing with Irish economics during the past two or three hundred years, the statement is either made or implied that the greater number of the native forests of the country were destroyed during the sixteenth and seventeenth centuries. The reasons assigned are usually the removal, by felling or burning, of the natural shelter of Irish rebels during the Elizabethan and Cromwellian wars, the smelting of iron by means of charcoal, the exportation of pipe staves, etc. In some cases even this assumed destruction is imputed to the mere presence of the English in the country, and it is suggested that the native Irish had a keen sense of forest preservation, whilst the various intruders were entirely devoid of this quality.

To the energy and enthusiasm of Mr. A. C. Forbes we owe the exposure of this myth. In "Some Legendary and Historical References to Irish Woods, and their Significance" (*Proc. Roy. Irish Acad.*, vol. 41, Sect. B, No. 3, Dublin, 1932) Mr. Forbes traces the past history of the forests of Ireland and has produced a treatise of considerable value, historical and economic, which it may be hoped will evoke similar essays for other countries.

The author took as his main study the writers of well-known histories, treatises and descriptions of the country on one hand, and State papers on the other. As an example of the former Mr. Forbes quotes the following extract from Lecky's "History of Ireland in the Eighteenth Century": "A serious and enduring change passed over the material aspect of the country in the forty years that followed the revolution (of 1640) from the rapid destruction of its forest trees. The history of this destruction is a curious and melancholy one. When the English first established themselves in Ireland, no country in Europe was more abundantly wooded." Lecky then quotes the various authorities upon whom he relied for making "this extraordinary statement" as Mr. Forbes terms it. It is impossible to follow the author through his review of these authorities but he conclusively shows the absence of all proof for the statements made. The references made in or to State papers and memoranda yield more satisfactory data, but Mr. Forbes says they must be read with caution.

Mr. Forbes summarises his conclusions as follows:

(1) No trustworthy account of Irish forests as a whole during the medieval period is in existence. The occupation of the country by the Normans and Tudors had no material effect upon the wooded condition of the country, although considerable quantities of timber were cut for pipe staves, and for conversion into charcoal during the latter period.

(2) The forest laws of the Normans were applicable to Ireland in the same way as in England, but there is no evidence that they were enforced except in one or two cases, which the author deals with at some length. The various references to "forest" in the State papers pertained to the unenclosed or unappropriated land of the country, which was regarded as the property of the Crown. This forest had no definite connexion with woods or timber. Many similar instances are to be found throughout the British Empire at the present day.

(3) The annals, legends, and other documents relating to the prehistoric period suggest that the condition of Ireland for an unknown period was that of a huge grazing ranch, over which trees were scattered more or less generally. More thickly wooded districts doubtless existed, but no clear indication of the extent can be discovered from the translations made in modern times.

(4) The Irish forest flora does not appear to have changed during the last thousand years. While the pine (*Pinus sylvestris*) may have survived until comparatively recent times, all the reliable evidence on this point is entirely negative in character.

(5) The native forests were gradually destroyed by grazing and fire, continuing over a very long period, and not by any large scale or deliberate acts of destruction.

On the subject of the composition of Irish woods, the legends and annals relating to the early Christian period throw a good deal of indirect light upon the species of trees which were in existence between the thirteenth and fourteenth centuries, when the majority of the legends were first inscribed or transmitted to parchment or paper. Topography forms a prominent feature of these old tales and poems and references are made to plains, woods, lakes and mountains which suggest a general landscape very similar to that existing to-day, while the frequent references to cattle show that flocks and herds formed the chief wealth of Ireland, as is the case to-day. In a tale entitled "The Death of Fergus", the scene of which is laid before the historic period, the following list of trees is given: ash, green oak (which may distinguish it from the bog oak so common throughout the country), aspen, rowan, alder, holly, blackthorn, whitethorn, briar, willow, apple, elder, birch and yew. Woodbine is referred to as "the Monarch of Inisfail's forests", but pine and elm are not mentioned. The list is almost identical with one which might be drawn up to-day in any piece of native scrub.

Perhaps one of the most interesting problems presented by the forest flora is the disappearance of the pine as an indigenous tree. This disappearance would appear to have taken place before the historic period. It constitutes the most plentiful species in bog remains all over the country. Mr. Forbes suggests that the causes may be the competition of oak and ash on the better classes of soils and the burning by graziers on the mountain slopes. In the absence of any proof to the contrary, the suggestion would appear to be the most likely one.

The Extra-Galactic Nebulæ

A DECISION has been reached by the Council of the Royal Astronomical Society that in view of the fact that the gold medallist for the year is so frequently the same person as the George Darwin lecturer, the latter may be expected to explain in his lecture the work for which the medal has been bestowed; and the president should be free to choose a subject of his own for his address at the annual meeting. The retiring president, Dr. H. Knox-Shaw, at this year's annual meeting held on February 10, chose a subject with which the medallist, Prof. Slipher, is closely connected, but on which many others have laboured in recent years, resulting in a great increase in our knowledge; this is the problem of the nature and motion of the extra-galactic nebulæ. Slipher was a pioneer in the study of their radial velocities; these proved to be large (the first forty gave an average of 620 km./sec.) and mainly outwards, though some of the nearer ones were approaching. The latter velocities were diminished on correcting for galactic rotation.

The address went on to describe the various types of nebulæ, including elliptical, spiral, barred-spiral, and irregular; the differences arise partly from different angles of projection, but chiefly from differences in the stage of development. The subject of their distance was then examined; the first reliable determination was that by Dr. Hubble from his detection of Cepheid variables in the nearer spirals; a distance of some 900,000 light-years was deduced for the great nebulæ in Andromeda and Triangulum. The measures were pushed some distance further by the magnitudes of the stars in the nebulæ; when this failed, estimates were made by the total light and angular diameter of the nebulæ. From these methods Dr. Hubble deduced − 13·8 as the average absolute magnitude of the nebulæ; Dr. Knox-Shaw suggested the value − 14·5.

Going on to consider the radial velocities, Dr. Knox-Shaw suggested that it was best to take these as a true Doppler effect in the absence of any other probable hypothesis; this was strengthened by the fact that the same radial velocity was indicated by lines in different parts of the spectrum.

A description followed of the special spectrograph by which Dr. Hubble has extended his study of radial velocities to the faintest and most distant nebulæ; this is done by diminishing the scale of the spectrum and giving prolonged exposures; recessions up to 19,000 km./sec. (equivalent to 200 angstroms for the *H* and *K* lines) have been found. The corresponding distance would be about 120 million light-years; estimates from different groups of nebulæ gave the mean recessional speed as lying between 590 and 400 km./sec. at a distance of one megaparsec. Dr. Knox-Shaw made an estimate of the average peculiar radial velocity of a nebula, including the dispersion in absolute magnitude; he found the value 140 km./sec. It is thus important for the nearer nebulæ, but a very small fraction of the whole for the distant ones.

In conclusion, Dr. Knox-Shaw said that the absolute magnitudes of the Cepheids, and all estimates of distance based upon them, are still subject to some revision. The original values were not corrected for the absorption of light in space; there is accumulating evidence that some correction is needed, but the exact amount is still uncertain. The galaxy appears to be of such a complex character that the absorption in different regions is probably different.

A comparison was made between the components of nebular clusters and isolated nebulæ; the former appear to be on the average fainter than the latter by amounts ranging from 0·5 to 0·9 mag. It will be seen that the address was not merely an account of the results obtained by others, but included personal discussion of the conclusions to be derived from them.

University and Educational Intelligence

Birmingham.—Dr. J. F. Brailsford has been appointed radiological demonstrator in anatomy and W. J. Rees temporary assistant lecturer in botany.

London.—The Leathersellers' Company has decided to make a grant to the University of £1,000 in the shape of annual payments extending over a series of years. This benefaction will be applied towards meeting the cost of the new Ceremonial Hall to be erected on the University's site in Bloomsbury.

The Pilgrim Trustees have decided to make a grant of £1,500, payable in three equal annual instalments, towards the cost of the preparation and the revision of existing material for the "Victoria County History". It will be recalled that in November of last year the University accepted an offer received from Mr. William Page, the sole proprietor and editor, to give to the University the copyright and material of the "History".

Reading.—The Council of the University has appointed Dr. R. H. Stoughton to be professor of horticulture. For two years Dr. Stoughton acted as mycologist to the Rubber Research Scheme of Ceylon, and for the past six years he has been a member of the research staff in the Department of Mycology at Rothamsted Experimental Station. The chair of horticulture at Reading has only recently been established and it is the first post of its kind in Great Britain. The training of students in horticulture has, however, been for many years a feature of university teaching at Reading and Dr. Stoughton will take over the whole charge of the Department of Horticulture. He will act also as director of the university Horticultural Station at Shinfield, where a garden of about 20 acres, including greenhouses and a well-stocked orchard, provides facilities for the instruction of students in the practice of gardening. The Station also affords opportunity for research in horticultural problems.

The Society for Cultural Relations with the U.S.S.R. has decided to arrange an education tour for the Easter vacation of 1933, the suggested date of departure being April 8. The tour will cover about 21 days, 6 days being spent in and around Leningrad, and 8 days in and around Moscow. All types of educational institutions, urban and rural, will be visited. Opportunities for making contact with Soviet educationists will be provided. A Russian-speaking English educationist will lead the party. The cost, which includes travel to and within the U.S.S.R., hotel charges, tips, visits to museums, etc., will be approximately £37. Further particulars can be obtained from the Secretary, S.C.R., 1 Montague Street, London, W.C.1.

Two Lady Tata research scholarships, of the value of £400 a year each, will be open for award in June, 1933, to men or women in the British Commonwealth, exclusive of India, for research work in the subject of blood diseases, with special reference to leucæmias. Each will be tenable for a year, from October 1, 1933, and renewable up to a normal maximum tenure of three years. The scholarships will ordinarily be awarded on a whole-time basis, but a candidate holding a part-time teaching post may be allowed to retain this if his duties will not prevent him from giving his chief interests and energies to his proposed research work. Applications should be sent, on or before April 15, to the Secretary, Dr. H. S. Patel, Lady Tata Memorial Trust, Capel House, 62 New Broad Street, London, E.C.2, from whom forms of application may be obtained.

Calendar of Nature Topics

Sowing Agricultural Seeds

The drills will soon be at work sowing spring corn. Broadcasting by hand, firmly associated in literature with the committing of seed to the ground, was universal until the sixteenth century and only slowly gave way to drill husbandry. It is now almost a lost art in Great Britain, and even when local circumstances make broadcasting necessary, it is usually done by machine. The forerunner of the modern seed drill was devised by Jethro Tull in 1701 and its introduction together with the principle of inter-row cultivation, which was part of Tull's system, represents one of the historical land-marks of agriculture.

With centuries of mechanical improvement it might have been expected that the present-day seed drills would be practically perfect. This is not the case. The ideal implement, sturdy enough to stand the rough usage of the farm, yet capable of distributing seed at a uniform and accurately adjustable rate from each of its many coulters, has not yet been constructed. Recent detailed studies of the distribution of the plant population in fields of cereals and roots have revealed a startling variation in density which is associated with equally marked differences in yield. Irregular sowing was found to be one of the main causes of this. There is no doubt that more uniform spacing of the seed in the rows would lead to higher yields, and when a demand for more accurate seed drills makes itself felt improved designs will be forthcoming.

Where do Flies go in Winter?

Gilbert White noticed that "in the decline of the year, when the mornings and evenings become chilly, many species of flies (*Musca*) retire into houses, and swarm in the windows", but he thought that they died there. There is, however, sometimes an interesting sequel to the autumn swarms of flies in houses. Generally in February, occasionally in January and March, householders in various parts of the country have complained about the appearance of swarms of flies. One such case was investigated in Edinburgh by Prof. J. H. Ashworth on February 22, 1916 (*Scot. Nat.*, 1916, p. 81). Swarms were then present in four rooms of a house, where for sixteen years they had congregated annually in September or October. Generally they disappeared before the end of November, but sometimes they persisted through the winter. The evidence suggests, however, that it was not a simple case of continuous persistence; for although Ashworth almost cleared one of the rooms on February 22, he found on March 7 that a considerable number of flies had again collected, as if they had emerged from crevices in which they had been hibernating. Only rooms with a southern aspect were affected, and at its largest the swarm in one room was reported to cover the bay-window and to have formed in addition a mass on the ceiling which resembled a thick coil of black rope some three inches in thickness.

Evidence of hibernation was more direct in the swarm which Major T. K. Gaskell observed at Lahill, Largo, Fife, in February 1915, for there he actually saw the small flies emerging from a crack behind the mantelpiece in his bedroom, which faced west. Probably their winter rest had been disturbed by the fire lit in the guest chamber. He collected in that, and the following year, some 700 individuals. Hever in Kent, Swindon in Gloucestershire, and other places have contributed all in one winter to the records of swarms of flies in houses, and show that the event is of wide occurrence.

Composition of Fly Swarms in Dwelling Houses

It is a remarkable fact that none of the swarms examined contained a single example of the common house-fly (*Musca domestica*). The swarms were really made up of a small anthomyid dipteron, *Limnophora septemnotata*, which was accompanied by odd individuals of muscid diptera, such as *Pyrellia eriophthalma*, *Muscina stabulans* and *Pollenia rudis*. A second interesting fact was that, in the two swarms fully analysed (Edinburgh and Largo), P. H. Grimshaw found all the specimens of *Limnophora* to be female. Ashworth's examination of ten specimens taken at random showed that all were impregnated, the receptacula seminis being crammed with active spermatozoa, presumably received in the previous autumn from males which had since died. The females alone carried on the race over winter, each survivor being ready, on the return of suitable conditions, to emerge from its winter quarters, feed, mature its ovaries, and produce eggs to be fertilised by autumn spermatozoa.

A third point of interest was that, as a rule, the dipterous swarms were accompanied by small hymenopterous parasites, the chalcid *Stenomalus muscarum*, the females of which are said to lay their eggs upon the larvæ of muscid flies. Moreover, all the hibernating chalcids of this species which Dr. James Waterston examined were females, and in describing the occurrence (*Scot. Nat.*, p. 140, 1916) he asked the pertinent question: "Is the occurrence of this Chalcid with the Diptera a fortuitous association to be explained simply on the ground that different species have selected the same winter quarters, or have we here an adaptation of habit on the part of the Chalcid enabling the parasite to oviposit most advantageously in the spring?"

Heredity and Hibernation in Insects

In his invaluable work on "Insects and Climate", B. P. Uvarov has summarised records regarding the hibernation of insects which suggest the existence in many species of a fixed seasonal life-cycle which may be disturbed by unusual temperature conditions but cannot readily be annulled by them (*Trans. Ent. Soc. Lond.*, 79, 105; 1931). Hibernation has become a habit which is fixed and is transferred with other heritable properties from one generation to the next. How has this habit become engrained in the course of evolution? It has been suggested that individuals in which the life-cycle was not properly adjusted to the conditions of environment would suffer and finally be eliminated, leaving only the well-adjusted to survive; in other words, that natural selection has been responsible.

Uvarov, however, refers to experiments carried out by Pictet on the caterpillars of the oak eggar moth which are very suggestive. His summary is as follows:—"Pictet (1913) himself bred caterpillars of *Lasiocampa quercus*, L., at 22° for six successive generations, with the result that, while in the first generation all caterpillars hibernated normally when the time arrived, in the fifth generation 52 per cent of the caterpillars were only inactive for one month, and 18·7 per cent developed without hibernation at all, and in the sixth generation practically all the caterpillars developed without hibernating. Under these conditions the adults can be obtained at almost any season, instead of in July–August, when they emerge normally, although about 50 per cent still tended to emerge at the usual time, owing to an adjustment in the length of the pupal period. Pictet used the results of his interesting experiment as an argument that the annual life-cycle is constant and hereditary, its origin being due to natural selection. They serve, however, to support even better the idea that the life cycle of a species can be directly influenced by the seasonal climatic cycle. Indeed, since only six generations were necessary to produce a substantial change in the life-cycle, in adjustment to new conditions, it is reasonable to suggest that a climatic cycle acting on a species for countless generations may make that species perfectly adjusted to it without the aid of natural selection." We have not seen Pictet's paper (*Bull. Soc. Lépidopt. Geneve*, vol. 2, pp. 179–206; 1913) and do not know whether the possibility of mortality in the different generations of his caterpillars may affect the argument, but progressive adaptation in generation after generation suggests something very like the inheritance of an acquired modification in the habit of hibernation.

Societies and Academies

London

Royal Society, Feb. 9. W. S. Stiles and B. H. Crawford: The luminous efficiency of rays entering the eye pupil at different points. It is commonly assumed that the apparent brightness of an object is proportional to the pupil area. This assumption is shown to be invalid, and measurements are described which give the relative luminous efficiencies of rays entering the pupil at different points. From these data, the overall luminous efficiencies of eye pupils of different diameters are computed, and checked by direct measurement. The effect may originate in the eye media or in the retina itself. R. J. Ludford: Differences in the growth of transplantable tumours in plasma and serum culture media. The malignant cells in tissue cultures of tumours can be distinguished from the non-malignant cells by the addition of trypan blue to the cultures, since the former do not segregate the dye like the latter. The two types of cells are further distinguishable by other characteristics. In plasma cultures, both malignant and non-malignant cells migrate from the explants. In serum cultures only non-malignant cells wander out from the explants. In serum cultures the explants of carcinomata soon become rounded and the explants of sarcomata tend quickly to disintegrate. The outgrowth of non-malignant cells in serum cultures is usually greatest when tumours are explanted at a time when they are not growing at their best *in vivo*. It is suggested that the different behaviour of malignant cells in plasma, and in serum, is the result of an alteration in their plasma membrane such that they are unable to adhere to glass, though able to use the fibrin network of a plasma clot as a support for their movement.

Mineralogical Society, Jan. 26. L. J. Spencer: Meteoric irons and silica-glass from the meteorite craters of Henbury (Central Australia) and Wabar (Arabia). The meteoric iron from these two localities is of exactly the same type, namely, a medium octahedrite containing 7·3 per cent of nickel. At Wabar a 25 lb. mass and a few small fragments of iron were collected; but at Henbury thousands of masses of iron are scattered around the craters. In the smallest (10 yd.) crater a group of four masses (440 lb.) was excavated at a depth of 7 ft. Many of the smaller pieces scattered around the craters are curiously twisted and bent, suggesting that they were torn in a plastic condition from the main masses by the force of the explosions. Further, they show a partial obliteration of the lamellar structure with granulation of the kamacite, indicating that they reached a temperature of 850° C. The pieces of iron show different types of pitting resulting from sub-aerial and underground weathering, and they are all weathered remnants of larger masses, each consisting of a single crystal. (See also Nature, 131, 117, Jan. 28; 172, Feb. 4, 1933.) A. Brammall and S. Bracewell: Garnet in the Dartmoor granite: its petrogenetic significance. Seventeen occurrences prove to be manganiferous almandines containing 3–22 per cent of MnO. Two or more varieties may occur in a single hand-specimen of the granite. The more manganiferous varieties (7 per cent MnO) are restricted to the tor-horizons; the less manganiferous varieties occur (*a*) below these horizons, (*b*) in shale-contaminated facies of the granite, and (*c*) in xenolithic hornfelsed shale. Basic igneous inclusions are barren of garnet, and grossularite, *not* almandine, occurs in contact-altered spilites. The mineral is attributed to contamination of the granite by country-rock—probably deep-seated shales. Ten Lake District occurrences show a similar variation (1·3 per cent–7·3 per cent MnO). F. A. Bannister: The identity of mottramite and psittacinite with cupriferous descloizite (cuprodescloizite); (with chemical analyses by M. H. Hey). Oscillation, Laue and rotation photographs show that descloizite has an orthorhombic unit-cell with edges $a = 6{\cdot}05$, $b = 9{\cdot}39$, $c = 7{\cdot}56$ A. and space-group Q_h^{16}. The unit cell contains $4PbZn(VO_4)(OH)$. Powder photographs of descloizite, cuprodescloizite, mottramite, and psittacinite from the type localities are identical with each other. New chemical analyses and determinations of the water content at various temperatures together with the X-ray work show that all these minerals may be represented by the general formula $Pb(Cu, Zn)(VO_4)(OH)$. The water of constitution is not evolved until a dull red-heat. Thin incrustations of minute black crystals on sandstone from Harmer Hill, Clive, near Shrewsbury, collected by Mr. Arthur Russell, are identical with mottramite from Mottram St. Andrew, Cheshire (H. E. Roscoe, 1876), that is, cuprodescloizite carrying little or no zinc.

Edinburgh

Royal Society, Jan. 9. J. G. Gray: Self-erecting gyrostats. The lecture was illustrated by experiments carried out with a large series of new gyrostatic tops and combinations invented by Prof. Gray and constructed with a view of demonstrating and explaining technique which he has developed for use in the practical applications of gyrostatics, notably in applications to the navigation of marine and aerial craft, and for use in the construction of stabilisers for use in such craft. J. E. Mackenzie and H. W. Melville: Experimental demonstrations of the measurement of the diffusion coefficients of bromine–hydrogen and bromine–carbon dioxide. This experiment is likened to a horse race in which all the horses have the same speed and colour (say chestnut), but each horse runs in a track differing in difficulty from the track of every other horse. Bromine molecules (chestnut horses) diffuse through tubes filled with hydrogen or carbon dioxide or other gas, and the distances covered by the bromine in each tube are measured visually at intervals of time. (See Nature, 130, 322, Aug. 27, 1932.) H. S. Ruse: The measurement of spatial distance in a curved space-time. A definition of spatial distance in a general space-time obtained in an earlier communication by a purely mathematical argument is in accordance with the concept of 'distance' fundamental in relativity, namely, that determined by the use of rigid measuring rods.

Paris

Academy of Sciences, Jan. 3 (196, pp. 1–71). H. Douvillé, M. Solignac and E. Berkaloff: The discovery of the marine Permian at Djebel Tébaga (extreme South Tunisia). St. Golab: The conformal representation of Finsler space on Euclidian space. Elie Cartan: Remarks on the preceding communication. S. Finikoff: Pairs of surfaces the lines of curvature of which correspond, the corresponding tangents cutting. **ARNAUD DENJOY**: The polygons of approximation of a rectifiable curve. **S. MAZUR** and **W. ORLICZ**: Linear methods of summation. **N. BOTEA**: Some partial differential equations. **J. DIEUDONNÉ**: Radii of *étoilement* and convexity of certain functions. **TCHANG TE-LOU**: The electrical and thermomechanical phenomena during ignition and combustion in an internal combustion motor. **DELFOSSE** and **SWYNGEDAUW**: Certain conditions of working of ball bearings. **F. HOLWECK**: Study of a sensitive elastic pendulum. Contribution to the establishment of a French gravimetric network. **P. LEJAY**: The establishment of the gravimetric map of the north of France. **S. SOBOLEFF**: The equation of the wave on the logarithmic surface of Riemann. **FRANCOIS CANAC**: Study of the mode of corrosion and of the susceptibility to corrosion of metals by the diffusion of light. **R. DE FLEURY** and **A. CAILLON**: The composition and mode of use of a flux assuring the protection of the metal, its refining and the elimination of chlorides in casting magnesium. **E. AUBERT DE LA RUE**: Some mineral deposits of the Saint-Pierre and Miquelon Islands. **H. ARSANDAUX**: The origin of the secondary dome of Mt. Pelée. **L. GRIGORAKI**: A new medium for preserving dermatophytes (pleomorphism, acquired characters, tissue specificity). **F. VLÈS**: Researches on the intervention of electrical conditions in the growth of children. **CH. SANNIÉ** and **R. TRUHAUT**: The mercury-reducing power of certain aminoacids. **JAMES BASSET** and **M. A. MACHEBŒUF**: Studies on the biological effects of ultra-pressures. Studies on immunity: the influence of very high pressures on certain antigens and antibodies. The toxin of tetanus loses its activity after exposure to a pressure of 13,500 atmospheres, but then possesses no immunising activity. It is not an anatoxin. At this high pressure antitetanus serum is precipitated as a jelly but the antitoxic power is not wholly destroyed. **A. LACASSAGNE**: Malignant tumours produced in the rabbit by the irradiation of inflammatory foci.

VIENNA

Academy of Sciences, Oct. 20. **JOSEF KISSER** and **H. SCHMID**: Investigations on the permeability of the seed coats of *Pisum* and *Triticum* to water and on the suction forces of the seeds. **J. KISSER** and **J. SCHUBERT**: The influence of treatment of seeds with chemical stimulants on the cell growth of the rootlets. When seeds of *Pisum* and *Triticum* are treated with alcohol, manganese sulphate or chloride, magnesium chloride or zinc sulphate in suitable concentrations and for suitable periods, considerable increase in root growth is produced. **J. KISSER** and **R. FURTAUER**: The influence of certain chemical agents on the carbon dioxide output of germinating seeds of *Pisum sativum* and *Triticum vulgare* under optimum germination conditions. In certain concentrations, alcohol enhances the production of carbon dioxide by *Pisum* seeds, but it is not certain if this effect is a true stimulative action or if it is due to the use of the alcohol as a nutrient. According to their concentration, magnesium chloride and manganese sulphate and chloride may either increase or diminish the output of carbon dioxide; the effect is influenced also by the presence or absence of the husk and by the phase of the germination when the salt solution is applied. **J. KISSER** and **FR. ZEISEL**: Physiological investigations on interrupted nutation. **J. KISSER** and **R. PIEPE**: Further investigations on the material foundations of tropistic curvature. **J. KISSER** and **I. BEER**: The chemotropic sensitivity of dicotyledonous seedlings. **ANTON KAILAN** and **OTTO STUBER**: The velocity of catalysed hydrogenations. The hydrogenation of oleic acid in presence of nickel and other catalysts supported on different carriers has been studied. **FERDINAND STEINHAUSER**: Temperature relations in Vienna during different seasons and at different times of the day (1931–1932). **JOSEF SCHINTLMEISTER**: The ionisation of H-rays in different gases. From the results as yet obtained, it must be concluded that this ionisation exhibits no abnormalities. **ULRICH KHUNER**: Experiments with space-acoustic models, and measurement of acoustic absorption coefficients. **K. F. WENCKEBACH**: The mechanism of sudden heart-failure in cases of beriberi. Observations made in the Dutch East Indies and Singapore indicate that the marked broadening of the right heart and the danger of speedy heart-failure accompanying beriberi depend on two factors, one cardiac and the other peripheral. These factors act from the beginning of the disease and are produced by the causes of the disease, but appear to differ essentially. **EMIL ABEL** and **HERMANN SCHMID**: Flow kinetics: model of photolysis. Certain special cases of flow kinetics, serving as a model of photolysis, are considered, and a kinetic interpretation of Beer's law of absorption is given. **FRANZ HOLZL** and **WALTHER STOCKMAIR**: The complex anion of Buff's compound and of Bunsen's salt. These compounds contain a common anion and are represented by the formulæ $(ROH.H)_4[Fe(CN)_4Cl_2]$ and $(NH_4)_4[Fe(CN)_4Cl_2]$ respectively. **MILOS MLADENOVIC**: Elemic acid from Manilian elemi resin (6): A new oxidation product of α-elemolic acid. **KONRAD FUNKE**: Perylene and its derivatives (37): Oxidation of dinitro- and diaminoperylene. **HANS KOPPER** and **ALFRED PONGRATZ**: The Raman effect (24): The Raman spectrum of organic substances (molecules with cumulated double linking). The vibration spectrum of allene corresponds exactly with that of a symmetrical linear molecule with a C : C double bond. With allene derivatives, cleavage of the principal frequency $\Delta\nu = 1074$ cm.$^{-1}$ occurs, and for the isocyanate group the frequency $\Delta\nu = 1420$ cm.$^{-1}$ is characteristic. **R. KREMANN**, **FRANZ GRIENGL** and **HELMUT SCHREINER**: The viscosity of partially miscible liquid mixtures (1): The system phenol-water. **ROBERT KREMANN**, **ESTER INGE SCHWARZ**, and **SIDY LE BEAU**: Experiments on the electrolysis of fused iron-aluminium alloys and the degree of solubility of iron in molten aluminium at different temperatures. **R. KREMANN** and **LUDWIG LAMMERMAYER**: The electrolysis of aluminium alloys containing iron as a model of the electrolytic purification of molten aluminium from iron. During this electrolysis, the iron migrates towards the cathode, but this effect diminishes as the aluminium content increases and is very slight for nearly pure aluminium. It is, therefore, improbable that aluminium can be freed from iron electrolytically. **LUDWIG LAMMERMAYER**: Electrolysis of a fused beryllium-copper alloy containing 10 per cent of beryllium. **ARTHUR PONGRATZ**, **FRANZ GRIENGL**, and **J. CECELSKY**: Perylene and its derivatives (38): Heats of combustion. **KARL LINSBAUER**: Action of calcium and potassium solutions on the protoplasm of *Chara*. **LUDWIG LAMMERMAYER**: Plants on the basalts of eastern Styria. **FRIEDRICH MORTON**: Results of a botanical expedition to Abyssinia, Egypt, and the Quarnero district (1931–1932). **RUDOLF WAGNER**: The existence of Δ-Sichel sympodia.

Forthcoming Events

Saturday, Feb. 18

ROYAL INSTITUTION, at 3.—Lord Rutherford: "Detection and Production of Swift Particles" (succeeding lectures on Feb. 25 and March 4 and 11).

Monday, Feb. 20

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—J. Vincent: "The Namuli Mountains, Portuguese East Africa".

Tuesday, Feb. 21

CHADWICK PUBLIC LECTURE, at 5.15—(in the Lecture Hall of the Royal Society of Tropical Medicine and Hygiene, 26, Portland Place, W.1).—Dr. M. B. Ray: "The Hippocratic Tradition".

BRITISH MEDICAL ASSOCIATION, at 8—(Sir Charles Hastings Lecture at the Association's House, Tavistock Square, W.C.1).—Sir Henry Gauvain: "Sun, Air, and Sea Bathing in Health and Disease".

Wednesday, Feb. 22

ROYAL SOCIETY OF ARTS, at 8—(Trueman Wood Lecture).—Sir William B. Hardy: "Industrial Research with Biological Material".

Thursday, Feb. 23

BEDFORD COLLEGE, LONDON, at 5.15.—"Contemporary Developments in Science." Prof. T. M. Lowry: "Chemistry in Three Dimensions".

Friday, Feb. 24

ASSOCIATION OF ECONOMIC BIOLOGISTS, at 2.30—(in the Botany Lecture Theatre, Imperial College of Science and Technology).—Annual Business Meeting.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS, at 5.30—(in the Lecture Hall of the Royal Society of Arts).—O. G. S. Crawford: "Air Photography and Archæology".

ROYAL INSTITUTION, at 9.—Prof W. A. Bone: "The Photographic Analysis of Explosion Flames".

ELECTRICAL ASSOCIATION FOR WOMEN, Feb. 22–24.—South-Western Conference to be held at Torquay.

ASSOCIATION OF TECHNICAL INSTITUTIONS, Feb. 24–25.—Annual Meeting. Feb. 24.—Sir Hugo Hirst: Presidential Address. Also, discussion on "Policy in Technical Education" to be opened by Dr. Percival Sharp.

Official Publications Received

GREAT BRITAIN AND IRELAND

True Temperance Scientific Committee. Monograph No. 9: The Altered Biological and Sociological Aspects of the Use of Alcohol. By Prof. D. F. Fraser-Harris. Pp. 12. (London: Donington House.) 6*d*.

Proceedings of the Linnean Society of London, Session 1932–33. Part 1. Pp. 48. (London: Linnean Society.) 1*s*. 6*d*.

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 31, Part 1, Session 1931–32. Pp. vii+243. (Edinburgh.) 10*s*.

Journal of the Royal Microscopical Society. Series 3, Vol. 62, Part 4, December. Pp. xvi+343–477. (London: Royal Microscopical Society.) 10*s*. net.

A Report on the Museums and Art Galleries of British Africa, by Sir Henry A. Miers and S. F. Markham; together with A Report on the Museums of Malta, Cyprus and Gibraltar, by Alderman Chas. Squire and D. W. Herdman, to the Carnegie Corporation of New York. Pp. ix+90. Directory of Museums and Art Galleries in British Africa and in Malta, Cyprus and Gibraltar. Pp. 61. (London: Museums Association.) With Report, 5*s*.

The National Institute for the Deaf. Memorandum by the Executive Committee of the National Institute for the Deaf on a Study of the Deaf in England and Wales, 1930 to 1932; being a Report by Dr. A. Eichholz to the Minister of Health and the President of the Board of Education, 1932. Pp. 9. (London.) 3*d*.

Journal of the Chemical Society. January. Pp. iii+114+x. (London: Chemical Society.)

The Joint Council of Qualified Opticians. Enquiry into the Manufacture of Gold-filled Spectacles. Pp. 34+12 plates. (London.)

War Office. Report on the Health of the Army for the Year 1931. (Vol. 67.) Pp. iv+158. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

Proceedings of the Cambridge Philosophical Society. Vol. 29, Part 1, 31 January. Pp. 164. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

(University of London): County Councils of Kent and Surrey. The Journal of the South-Eastern Agricultural College, Wye, Kent. No. 31, January. Edited by Dr. S. Graham Brade-Birks. Pp. 74. (Wye.) 2*s*. 6*d*.; to Residents in Kent and Surrey, 1*s*. 6*d*.

OTHER COUNTRIES

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 10, Part 4, December. Pp. 805–910+plates 92–98. (Tokyo: Iwanami Shoten.) 1.50 yen.

Seismometrical Report of the Earthquake Research Institute, Tokyo Imperial University. 1932, Part 2 (April–June, 1932). Pp. 7–11+plates 3–9. (Tokyo.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 31, Part 3: Studies on the Proteins and Oil of Soy Bean. By Kenzo Nakajima. Pp. 165–356. (Tokyo: Maruzen Co., Ltd.)

Japanese Journal of Engineering. Abstracts, Vol. 8. Pp. xi+89. (Tokyo: National Research Council of Japan.)

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30th, 1932. Pp. vi+181. (Washington, D.C.: Government Printing Office.)

République française: Ministère des Affaires étrangères. Procès-Verbal des séances de la deuxième Conférence Internationale pour les recherches antiacridiennes, Paris, 15 juillet–23 juillet, 1932. Pp. 29. (Paris: Editions de la Société Entomologique de France.)

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 20, No. 10: *Agonostomus Hancocki* Seale. sp. nov. By Alvin Seale. Pp. 467–469. (San Francisco.)

Bulletin of the National Research Council. No. 87: Possibilities and Need for Development of Legal Medicine in the United States; with a Supplement on University Departments in the Field of Criminology. By Dr. Oscar T. Schultz. Pp. ix+135. 1.50 dollars. No. 88: Summary Information on the State Geological Surveys and the United States Geological Survey. Pp. iii+136. 1 dollar. No. 89: Report of the Committee on Sedimentation, 1930–1932. Pp. 229. 1 dollar. (Washington, D.C.: National Academy of Sciences.)

Proceedings of the American Academy of Arts and Sciences. Vol. 67, No. 8: The Pressure Coefficient of Resistance of Fifteen Metals down to Liquid Oxygen Temperatures. By P. W. Bridgman. Pp. 305–344. 75 cents. Vol. 67, No. 9: The Compressibility of Eighteen Cubic Compounds. By P. W. Bridgman. Pp. 345–375. 75 cents. Vol. 67, No. 10: The Saltatorial Rodent *Dipodomys*, the Functional and Comparative Anatomy of its Muscular and Osseous Systems. By A. Brazier Howell. Pp. 377–536. 2.20 dollars. (Boston, Mass.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 84. South American Land and Freshwater Mollusks, 8: Collections of the Carriker-Roberts Peruvian Expedition of 1932. Pp. 387–402. (Philadelphia.)

Annual Report of the Naval Observatory for the Fiscal Year 1932. Pp. 22. (Washington, D.C.: Government Printing Office.)

Reprint and Circular Series of the National Research Council. No. 102: Directory of Research in Child Development. Compiled by J. Allan Hicks. Pp. 74. 50 cents. No. 103: Ninth Report of the Committee on Contact Catalysis. By J. N. Pierce. Pp. 42. 50 cents. No. 104: Doctorates conferred in the Sciences by American Universities, 1931–1932. Compiled by Callie Hull and Clarence J. West. Pp. 59. 50 cents. (Washington, D.C.: National Academy of Sciences.)

South Australia: Department of Mines. Mining Review for the Half-Year ended June 30th, 1932. (No. 56.) Pp. 80. (Adelaide: Harrison Weir.)

South Australia. Annual Report of the Director of Mines and Government Geologist for 1931. Pp. 8. (Adelaide: Harrison Weir.)

Conseil Permanent International pour l'Exploration de la Mer. Bulletin hydrographique pour l'année 1931. Pp. 136. 7.00 kr. Rapports et procès-verbaux des réunions. Vol. 81: Procès-verbaux (Juin 1932.) Pp. 236. 9.00 kr. Journal du Conseil. Vol. 7, No. 3. Rédigé par E. S. Russell. Pp. 339–448. 4.50 kr. Tables for the Determination of the Density of Seawater under Normal Pressure, σ_t. By Donald J. Matthews. Pp. v+56. 4.00 kr. (Copenhague: Andr. Fred. Høst et fils.)

Calendario del Santuario e delle Opere di Beneficenza Cristiana di Pompei, 1933. Pp. 288. (Pompei.)

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The Ancient Monuments of England

POSSIBLY few of the public who visit our ruined castles, abbeys and other historic sites are conscious of the extent of their indebtedness for their æsthetic enjoyment or the satisfaction of their intellectual interest to the activities of the Office of Works in the exercise of the powers conferred upon it under the Ancient Monuments Acts. The Friday evening discourse on "The Ancient Monuments of England" delivered by Sir Charles Peers, the Inspector of Ancient Monuments, at the Royal Institution on January 27, served a double purpose by demonstrating the various forms of activity of the Office of Works in carrying out this branch of its duties, and in reminding his hearers why these duties should have come to be accepted as the responsibility of a government department functioning at the charge of the State.

The sense of national responsibility in the matter of the preservation of ancient monuments and buildings, which afford concrete evidence of the life and history of Britain in the past, has been a plant of slow growth. As Sir Charles Peers pointed out in opening his address, the term 'ancient monument' has been in use no more than fifty years ; nor does it even now apply to every monument of antiquity. Until recent legislation, it covered only certain restricted classes of prehistoric remains ; and it does not apply to any church, inhabited house, or to Crown property. Although Sir Charles did not dwell on this aspect of his subject, the dangers are patent.

Any building or structure which falls within these latter categories, whatever its historic interest or æsthetic value, is at the mercy of any craze for 'improvement' or restoration, however well- or ill-instructed, or even, in the instance of the private owner, of desire for pecuniary gain. In the not very remote past, priceless panellings and carvings in wood and stone have been torn from their settings and sent to America ; and only a year or two ago the historic palace of Queen Elizabeth at Enfield was demolished, although a public-spirited purchaser was ready to forgo a handsome profit, had a public body been prepared to accept his offer to sell at a comparatively low price. An object-lesson of the enforced impotence of the Office of Works is afforded by the reply of Mr. W. J. Ormsby-Gore, as First Commissioner of Works, when asked recently in Parliament if his Department would not intervene to secure the preservation of the historic buildings of the Adelphi on the Thames Embankment. Archæologists who are more immediately concerned with the preservation for science of the material bearing on the period before written records, have shown repeatedly that they would welcome a greater measure of control over the exploitation of privately owned sites of archæological interest.

It must be admitted that under recent legislation great advance has been made, especially in the field of prehistoric and early historic times. The recent additions to the list of scheduled 'monuments' mark a greatly extended range for the operation of the Acts. Individual acts of vandalism, it may be assumed, will always be with us; but public opinion may now, perhaps, be credited with being so far educated as to deprecate, and even to do its best to prevent, anything like the wholesale destruction which threatened the stone monuments of Dartmoor or the neglect which allowed a monument like Stonehenge to fall into a deplorable condition a generation ago. It is rather the less conspicuous and spectacular sites which call for 'protection'.

Sir Charles Peers spoke of the distinguishing marks which primitive man by the use of his hands has set on natural objects, marks which set him apart from all other living things. These are documents beyond price for the study of the early history of man. While, as Sir Charles said, the work of man can never be obliterated by natural forces, it is equally true that it can be defaced and destroyed by man himself. However meagre, scattered, or insignificant, such evidences of man's early progress should be preserved from the destructive activities of both ignorance and deliberate vandalism.

Speaking more particularly of prehistoric antiquities, this desire to preserve even the least vestige that has survived from the past arises from no spirit of mere antiquarianism. Those who for many years pressed for the enlargement of the powers conferred on public authority under the Ancient Monuments Acts had more in mind than preservation for its own sake. Their object, from the point of view of archæological science, was immediately practical—the preservation of the data with which the archæologist must work. If we are able to present a connected story of the past in Britain from the time of our later stone age, say, 2300–2000 B.C., as Sir Charles Peers said, even though we cannot lay claim to a civilisation comparable to the venerable culture of Mesopotamia or ancient Egypt, it is due to the synthetic studies of those who by patient plotting of scattered details on distribution maps have elicited conclusions out of all proportion to the apparent significance of any one piece of evidence taken in isolation. Yet in many instances such evidence has survived by happy chance rather than of design.

As an example of what has been achieved, Sir Charles surveyed present archæological theory of the early peopling of the British Isles by the megalithic peoples and the beaker-folk; and in another connexion he spoke of the results of the series of excavations which in recent years have been carried out on the hill-top camps in different parts of the country. He might also have referred to the enlargement of our knowledge of the mode of life of prehistoric peoples which has come from single sites where there was little to show the casual observer before investigation, such, for example, as the home of the flint-miners of Blackpatch in Sussex and, had Scotland come within his purview, the bronze age village at Skara Brae, explored with the co-operation of the Office of Works under the direction of Prof. V. Gordon Childe, the most remarkable and illuminating habitation site of that period north of the Alps.

In emphasising the evidential value of material, much of which may be comparatively unimpressive, and the need for its preservation, it must be remembered that there is another side to the question. We owe a duty to posterity. There are at least two reasons why we should hand on to our descendants these evidences of antiquity in a state of preservation at least not less secure than we have received them. On one hand, they are the possessions not of a day, but for all time. On the other hand, if there is one lesson to be learned from the progress in archæological studies during the last ten or fifteen years, it is that both method and theory in archæology are being developed with great rapidity. Hence it behoves us to preserve untouched at least a part of that material to serve the needs of a generation better instructed than our own. On more than one occasion recently, directors of excavations have recorded that they have left part of a site untouched for future investigators. This might well be made a condition of permission to excavate or of the co-operation of the Office of Works in the examination of a site.

In looking to the rights of future generations, it is inevitable that the question of repair and restoration should arise—a question of considerable difficulty in which, however, no better guide could be sought than Sir Charles Peers himself. Happily for the prehistorian, this is a question of less complexity in dealing with a prehistoric monument than it is for those who have the charge of early historic or medieval buildings. Repair, in the view held by Sir Charles Peers, should be reduced to a minimum, and considered as auxiliary to archæological investigation. As an illustration, he referred to the recent work carried out under the supervision of the Society of Antiquaries at Stonehenge where, after this monument had been presented to the nation in 1919, steps were taken to prevent the fall of unstable uprights, and much valuable information bearing on the methods employed by the builders of the monument was obtained. Under present legislation, the future of our prehistoric monuments should be secure. They need for the most part nothing more than that they should be left undisturbed, pending the time when their careful examination in the interests of scientific archæology may be thought desirable.

The difficult question of repair and maintenance was more nearly germane to the latter part of Sir Charles's lecture, in which he dealt with the more representative monuments of the early historic periods, Roman, Saxon, Dane and Norman. Here the question is not one of sites but of buildings, and he showed his audience in some detail the work that has been carried out with the co-operation of the Office of Works on such historic monuments as the coast-fortress of Anderida, now Pevensey, Portchester Castle, Whitby, Rievaulx and Byland, where much has been learned of medieval life and technical achievement from what in some instances, before operations began, had been no more than grass-covered hillocks.

Enough has been said, it is hoped, to indicate why the preservation of ancient monuments should be regarded as a national duty under the supervision of a public department, as is the safe custody of written records. The latter, however, stand in a different category. They can be kept under conditions which ensure their safety, so far as that is humanly possible, and they are accessible to the public only under proper supervision. Ancient monuments, we may say in a large number of instances, cannot be kept under 'lock and key'. Further, they are open to the vicissitudes of the weather and other causes of decay; hence the appeals to the purse of the public, when some building of historic interest and importance is in danger, as happens, unfortunately, all too frequently. The Ancient Monuments Acts may ensure the protection of a site or structure in a technical sense by including it in the schedules to the Acts. They cannot thereby make provision for its maintenance, and this may involve a heavy sum. The best protection for an ancient monument is a public which has been trained from school age to recognise and reverence with understanding the relics of its past; and the maintenance of a monument which is a national treasure should be a public charge.

Diamonds

The Genesis of the Diamond. By Alpheus F. Williams. Vol. 1. Pp. xv+352+vi+89 plates. Vol. 2. Pp. xii+353–636+iv+plates 90–221. (London: Ernest Benn, Ltd., 1932.) 84*s*. net.

THE author of this monumental work on the diamond has supreme claim to authority on the subject, having been connected with the diamond industry for more than thirty years, latterly as general manager of De Beers Consolidated Mines, Limited, and consulting engineer to the Jagersfontein and Koffyfontein mines, and in former years as assistant to his predecessor in that post, his father, Dr. Gardner F. Williams, whose book, "The Diamond Mines of South Africa", published in 1902, gave the first authentic account of the rise and development of the diamond mines of South Africa. The present book is not confined to its titular subject, but gives also a very readable account, fully illustrated, of the present-day practice of diamond mining and recovery, as adopted by the De Beers Company at Kimberley and elsewhere, as well as a chapter on the alluvial diggings in the diamond-bearing gravels of South Africa.

So long ago as 1899, Mr. Alpheus Williams had started to record data bearing on the origin of the kimberlite pipes (the 'blue ground') and fissures, and the nature and genesis of the kimberlite itself. He also commenced making a collection of diamonds, the natural uncut crystals, with the object of determining the conditions under which the diamond crystal grows. Those who, in 1929, had the privilege of seeing this collection, and that of the crystal-inclusions other than diamond in the kimberlite, as well as the wonderful series of photographs showing the surface structure of diamond faces and the internal markings and enclosures, and photomicrographs of rock and crystal sections, will best appreciate the immense value of this unique private museum—for such it amounts to. All must rejoice that wishes, then so fervently expressed for publication of a book dealing with it, shall have come to fruition.

One of the most interesting and successful pictures in the book is one in colour of the collection of uncut diamonds, natural size. There are also coloured reproductions of the more important of the 500 photomicrographs of rock-sections, most of the actual sections having been one and a half inches in diameter, in order the better to display the complete structure. Very valuable also are the many large-size photographs exhibiting practically every variety of diamond twinning, including cyclical and polysynthetic twins, as well as the star shapes and other better-known types. There are also projection-growth and cavity-form photographs, and others illustrating the glide planes in diamond.

Mr. Williams's mature view is that the kimberlite magma was of very deep-seated origin, genetically related to the magma which produced the ultra-basic rocks; and that, after the solidification of these latter rocks, they were fractured and at the time of the rise of the kimberlite magma fragments of them were carried up and eventually became impounded in the kimberlite at the time of its solidification. As regards the shape of the pipes, filled with kimberlite, the statement that they are generally round or elliptical in section, and resemble circular vents, is incorrect, this only applying to the shape near the surface; at greater depths they become more and more simple fissures. Some very convincing diagrammatic sections are given of the Kimberley pipe at different depths. The pipes are shown not to be volcanic craters or necks in the ordinary sense of the terms, but simply enlargements of a single fissure or of a junction of two fissures. Mr. Williams has found no evidence in support of the view so often expressed that violent explosive action had occurred during the rise of the molten magma which is now found filling the pipes and fissures. The explosive action occurred when the fissure was formed, before the rise of the kimberlite magma. Probably, owing to more rapid cooling, the magma solidified first in the fissures, while the contents of the enlargements, the pipes, were still more or less plastic, so that very little intermixture of lower and upper magmas could have occurred. Hence fissure kimberlite is generally of lower diamond content than pipe kimberlite.

The author further explains that crystallisation of carbon into diamond started on a limited scale in the very early stages of the solidification of the original magma into the plutonic rocks found now as cognate inclusions in kimberlite. That the carbon had already crystallised at this stage is proved by the fact that some of these cognate inclusions carry diamond. The condition most favourable for the crystallisation of the diamond would probably follow some process whereby the carbon content of the magma would be concentrated. This would occur in the first instance during the period of the crystallisation and formation of the peridotite and pyroxene rocks, and a further concentration would occur when the magma began to rise. The conditions for the crystallisation of carbon into diamond would therefore be more favourable in the magma left behind. It was in this residual magma, before its ascent in the fissures and pipes, that the crystallisation of diamond was greatest. This richer portion in turn rose and intermixed with semi-plastic magma already filling the pipe.

As to the genesis of the diamond itself, it is now generally accepted that the diamond was not crystallised in situ. The author shows that kimberlite is essentially a mica-olivine rock containing many transported crystals of olivine, enstatite, garnet, diopside, phlogopite, and so on, as well as clusters of these minerals, and as the diamond was one of the first minerals to crystallise it must therefore also be a transported mineral. The diamond has already been shown to have crystallised out of the original magma before eruption, and in some cases before the solidification of the peridotite and pyroxene rocks, for these rocks occasionally carry diamonds, as already mentioned. The bulk of the diamonds, however, must have crystallised out of the magma which remained after the formation of the peridotite and pyroxene rocks. At the same time, there crystallised magnetite, graphite, ilmenite, garnet, diopside, olivine, phlogopite, and zircon.

In spite of the numerous attempts to reproduce diamonds artificially, the author does not believe that anyone has yet imitated the process of Nature. Enormous sums of money have been expended in the quest, but grave doubts are felt as to the justification of claims that experiments, however costly, have resulted in the creation of diamonds.

Sir William Crookes in 1897 at the Royal Institution, and again in 1905 at Kimberley, expressed the view that the diamond problem was no longer insolvable, in view of the development of the electric furnace. Yet to-day, twenty-eight years later, we appear to be in the same position, with no practical advance effected. In 1924 Sir Charles Parsons said that he had been trying to make diamonds for twenty years, and had spent twenty thousand pounds on his experiments, but had come to the conclusion that nobody had ever made diamonds, the claims of Prof. Moissan and Sir William Crookes having been mistaken.

As regards the crystal form and structure of the diamond, there can no longer be any doubt that it belongs to the highest, holohedral, class 32 of the cubic system. The frequent suggestions for a lower class of the system ('hemihedrism') are really due to the fact that the diamond in habit assumes more 'forms' of the same system than any other crystallised substance, garnet most nearly approaching it in this respect. The different conditions under which the crystals have separated from the magma are probably responsible for this, the influence of surface tension in the liquid from which they separated being very pronounced. For the formation of a crystal face is dependent on two forces, the interatomic force striving to produce characteristic planes at right angles (normal) to the attractive force, and the force of surface tension counteracting this and striving to produce sphericity.

Temperature, fluidity, sizes of atoms, all are factors in determining the resultant of these opposing forces. The striving for sphericity, while at the same time the crystallographic laws are being obeyed, is clearly shown by the diamond, which so often takes its full 'form', that of the hexakis-octahedron, the 48-faced solid which is so nearly spherical. When this force is less effective, the tetrakis-octahedron is produced instead, hence the claims for hemihedrism. Fortunately, X-ray analysis has decided that the diamond is truly holohedral, a conclusion further confirmed by piezo-electric experiments at Cambridge by Dr. Wooster, with diamonds provided by the author. The whole of Mr. Williams's own work and investigations in so many directions are in agreement with this conclusion.

A most fascinating chapter, illustrated by exquisite photographs, follows on the growth of the diamond, which must be read to be appreciated. A pathetic statement occurs here, showing how commercialism so often impedes instead of helping scientific work. It reads: "An interesting feature may appear on the face of a diamond worth ten thousand pounds, the only record of which will be the photograph, because once the diamond enters the trade it is lost for ever from a scientific point of view." Hence, the world of knowledge is deeply indebted to the author of this delightful and valuable book for having secured these photographic records at the one and only psychological moment possible in each case, on the passage of these gems, Nature's loveliest of all crystals, from the 'pulsator' and sorting room of De Beers at Kimberley to the diamond cutter's destructive workshop. A. E. H. TUTTON.

Animal Myths

Animal Lore in English Literature. By Dr. P. Ansell Robin. Pp. ix+196+8 plates. (London: John Murray, 1932.) 10*s.* 6*d.* net.

THE author of this book so nicely adjusts the balance between weight of learning and popular interest that he charms the scholar and the arm-chair reader alike. The growth of legends and myths concerning animals is traced from the earliest European literature to the times in which science has destroyed belief in them, while leaving them to embroider literature.

The first sources of legends were oral, and many of these myths which appear in the early classics originated in Egypt or in south-west Asia. Oral tradition was supplemented by mythological and astronomical fancies, and animal symbolism became a feature of early civilisations.

Aristotle among the early writers was remarkable in that he used personal observation in dealing with the animal world, whereas later writers, up to the sixteenth century, culled their natural history from earlier records or tradition. The Alexandrian Christian writers used animals as emblems of ethical and religious truths, and such ideas spread over the whole intellectual tradition of literary nations, appearing in writings, architecture and heraldry. Collections of allegories, in which animals appear, were called bestiaries, and the wild imaginings were drawn from legends, classical sources and the Septuagint.

The use of such fables and allegories persisted all through the Middle Ages, although sometimes the appeal was worldly and unedifying rather than ethical. Dryden in the "Hind and the Panther" used the beast allegory in writing of the Roman Catholic and English Churches.

Many legends centre round the mysteries of birth and death. The ancients believed in spontaneous generation for insects, eels and worms, even to the time of Isaac Newton. The young of a bear was supposed to be born a formless lump and licked into shape by the mother's tongue—hence our expression 'an unlicked cub'; the reviewer confesses to a former belief that this referred to a lack of corporal punishment. The barnacle goose was believed to originate from deal planks soaked in salt water, from which grew barnacles; these in turn dropped young geese into the sea, and these last swam away to the fens and inland waters: this belief appears in English literature from A.D. 750 until the seventeenth century. The story of the Phœnix is traced from Egypt and occurs in literature from Hesiod's days—Aristotle indeed ignores it, but Tacitus, Tertullian and the Alexandrian fathers all give versions of it. The dragon was a monster common to the literature and beliefs of the whole world from the earliest times.

The history of the unicorn is instructive. It appeared as a distinct animal in the Septuagint, through a mis-translation of the Hebrew word 'reem' as 'unicorn' (Revised Version 'wild ox'), though the context shows that the animal was two-horned. The legendary one-horned beast was adopted widely, and Greek stories of a fierce one-horned Indian ass were transferred to it. This beast being reported as notably gentle to the female in the mating season, the legend grew up that the unicorn could only be subdued by a virgin. About Pliny's time the rhinoceros became known in Europe, and the facts about it and the legends of the unicorn became mingled, so that the subjugation of the rhinoceros by a virgin is related by Isidore in the seventh century. When later still, the narwhal's tusks, spirally twisted, were found on the shores of northern latitudes, they were hailed as unicorn's horns; these were supposed to possess magic curative powers, and the powdered horn was sold by apothecaries for more than ten times its weight in gold.

The basilisk appears in the Septuagint as a serpent, and by Pliny's time was a fearsome beast. Later we find the Englishman Neckam writing that a cock nearing old age lays an egg which is hatched by a toad, and from it emerges a basilisk. Vincent of Beauvais, and Glanvie, on the authority of the Venerable Bede, add to the beauty of the story by giving to the basilisk, thus hatched, the body of a cock and the tail of a serpent. By the fourteenth century we get the alternative name cockatrice, in Wycliff's Bible for example. This name probably came from the Latin 'crocodilus', through low Latin 'cocodrillus'.

Besides such legends, we have the interesting, if mistaken, beliefs in the power of the hyæna and the hare to change their sex, of the eagle to renew its youth, referred to by the Psalmist: in the super-devotion of the pelican, in the purposeful deafness of the adder.

What farmer of to-day would give credence to the statement that a collar made of the wood of the fig will subdue the wildest bull? Or that a stag draws forth snakes from their holes by the indrawing of his breath? The goat and deer family were stated, even by the cautious Aristotle, to use the herb dittany to eject wounding arrows from their bodies, and Pliny's statement that the blood of a goat would split a diamond into pieces was accepted without question. Pliny, too, refers to the belief that goats were never free from fever, folk-lore which is interesting because of the recently established connexion between goats and relapsing fever.

These and many other stories are enlivened by collotype illustrations from early manuscripts, herbals, etc. Surely every naturalist must appreciate the appearance and habits of these beasts and must feel a faint envy of his predecessors' ability 'to get away' with stories, untrammelled by cold facts.

E. G. G.

Vitamins

Les vitamines. Par Mme. Lucie Randoin et Henri Simonnet. (Collection Armand Colin: Section de biologie, No. 145.) Pp. iv+220. (Paris: Armand Colin, 1932.) 10.50 francs.

TWO distinguished French workers in the field of vitamin chemistry and physiology have attempted in this little book a task the difficulty of which can probably be appreciated to the full only by those who have attempted the same or a similar one. To take a living and growing subject, especially in the biological sciences, and attempt to expound it to the non-technical reader, is to run one of two risks. Either everything may be made artificially simple by the use of too facile generalisation, by the suppression of inconsistencies and difficulties, by presenting as accepted facts what are actually only the author's interpretations of facts; or the saving clause and the citation of unexplained exceptions, the clumsy attempt to describe in words of one syllable what can only be defined neatly in words of many, the patronising parenthesis and the irritating footnote—all these may combine to scatter and confuse the reader. In the former case, technical colleagues look askance, and rightly: in the latter, non-technical readers turn away, and naturally.

Mme. Randoin and M. Simonnet have on the whole steered an admirably clear course between this Scylla and that Charybdis. If their treatment of the subject invites any serious criticism at all, it is for a little inconsistency of outlook as to the knowledge of their potential readers, and this is perhaps because they are *physiologists rather than* biochemists. Consequently they tend to indulge in undue detail of explanation when discussing the chemical aspects of vitamins and in undue use of medical phraseology when describing the clinical manifestations of deficiency diseases.

It is inherent in their subject that some of what the authors have written is already quite out of date, though their book was only published last year and they actually cite the results of research published in the middle of 1931—such as the preparation of crystalline vitamin D products. In spite of this, the book should prove an invaluable guide to those who wish to learn or to relearn the outlines of a subject increasing in importance and in the recognition of its importance. To the technical reader perhaps the most interesting feature will be the light shed by the book on the French view of the vitamin B complex—a view to which its authors have so largely contributed by their own investigations. Their insistence, too, that vitamin C is concerned with iron metabolism will come as a new conception to most English readers. But it is surprising to find such careful and up-to-date workers advocating without qualification the use of purified butter-fat in a rachitogenic diet (p. 91), more especially since their observations on p. 84, that "la vitamine à doser puisse être séparée de tous les autres principes alimentaires, lesquels ne doivent pas en contenir la moindre trace" illustrates unequivocally an essential principle of biochemical methodology.

The book shares with many books published in France the defect of having no index, but its general production and format call for little criticism, especially in view of its extremely low price. A. L. B.

Short Reviews

The Physics of High Pressure. By Prof. P. W. Bridgman. (International Text-Books of Exact Science.) Pp. vii+398+5 plates. (London: G. Bell and Sons, Ltd., 1931.) 22*s.* 6*d.* net.

PROF. BRIDGMAN has achieved an international reputation for his researches into the properties of matter under high pressures, so the volume under review is assured of a warm welcome by all who have studied the work which has been so assiduously pursued during the past twenty-five years. Prof. Bridgman is known personally to many on the eastern side of the Atlantic for in 1929 he gave the Guthrie lecture to the Physical Society.

Whilst the primary aim of the volume under review is to give a résumé of Prof. Bridgman's own work, the contributions of others are duly recorded. In the first chapter, which is of a historical character, will be found 12 pages of references to work on this subject antedating that of Prof. Bridgman's. The book constitutes a comprehensive handbook on the technique of physical measurements under enormous pressures; a technique which is highly specialised.

Although the subject at the present time is of purely scientific interest, the fact must not be overlooked that many chemical reactions are now being carried out under moderately high values of both pressure and temperature on an industrial scale, so the experience gained in the laboratory will in due course find application in the field of technology. The theoretical side of the subject has not advanced much but the quantitative description of a large number of high pressure phenomena may be expected to have some ultimate theoretical significance.

Prof. Bridgman tells a story of absorbing interest, the fare he provides is both interesting and enduring and the book may be recommended to those whose appetite has become jaded through a surfeit of speculative physics. In this volume we are told how pressure affects the various physical properties of matter such as the electrical resistance, the thermo-electric property, viscosity, the thermal conductivity, etc. E. G.

Fuel Testing: Laboratory Methods in Fuel Technology. By Godfrey W. Himus. Pp. x + 257 + 5 plates. (London: Leonard Hill, Ltd., 1932.) 15*s.* net.

MR. HIMUS, lecturer in fuel technology at the Imperial College of Science and Technology, has made it his business to collect the latest available data regarding this most important subject and put it together in a volume which forms a veritable treatise. It is refreshing to find a book which deals specifically and clearly with a single subject, and carries it through from A to Z.

Naturally, due to his associations with Prof. W. A. Bone's laboratory, the work done at that institution has received first consideration, but Mr. Himus also describes methods adopted by various other official institutions and private investigators which have been proved in practice to be suitable for the purpose in view. He describes in considerable detail and with all desirable clearness the various stages in fuel analysis, and whenever he deviates from the original investigator's rules and regulations he always carefully gives his reasons for doing so, and they are generally good enough to be accepted by anybody.

New fuels are coming into use every day for new purposes, and Mr. Himus's book, compact as it is, provides a valuable guide. It is well indexed, well illustrated, well printed, and should be found in the reference library of everybody interested in the winning and using of fuel.

The Case Against Einstein. By Arthur Lynch. Pp. xxx+275. (London: Philip Allan and Co., Ltd., n.d.) 10*s.* 6*d.* net.

Many thinkers, even among the "hierophantic display of the professors" who support Einstein, will be with Col. Lynch in some details of his enthusiastic criticism of the theory of relativity. The paradoxes of simultaneity, the variability of mass and the extraordinary properties of the space-time continuum, are stuffed with implications which need clarification. Einstein himself has said that his task is not yet completed. But it seems that Col. Lynch goes too far in asserting that the theory of relativity consists in giving to mathematical expressions strained meanings and in setting down as realities what are conventional modes of representing operations. In reading his book, one cannot make out whether it is addressed to the crowd, whom he despises, or to the learned, who share in his general impatience with all who disagree with him. In the first case, the author's plea would have been amusing if it was devoid of the specks of learning he places here and there. In the second case, Col. Lynch might have induced "the pundits" to give him a hearing, if he refrained from mixing his integrals with emotional remarks and irrelevant stories about himself and others. As it is presented, the book has, at times, an irritating flavour, where it could have been courageous and useful. T. G.

The Great Age of Discovery. Edited by A. P. Newton. Pp. xi+230+31 plates. (London: University of London Press, Ltd., 1932.) 15*s.* net.

The chapters of this book consist of a series of lectures given by seven different authorities in King's College, London, designed to cover the great movements in discovery during its most fruitful age. It is not, however, merely a series of disconnected episodes, since each great voyager is regarded in his historical setting and the whole gives a coherent view of the development of the map of the world during the late fifteenth and early sixteenth centuries. Each lecture is thoroughly documented with references to original sources and there are reproductions of old maps as well as other illustrations.

In his chapter on Columbus, Prof. Newton gives reasons for discarding the story about the Toscanelli letters, and is inclined to accept Vespucci's account of his second and third voyages and to suspend opinion on his first voyage. He believes that Tristan da Cunha and not South Georgia was the southern island that Vespucci claimed to have discovered in 1502. These are merely examples of the many problems that are reviewed throughout the volume.

Il polarografo: sua teoria e applicazioni. Per Giovanni Semerano. Pp. vii+207. (Padova: A. Draghi, 1932.) 16 lire.

The polarograph is an apparatus devised by Prof. Heyrovský and Dr. Shikata at the Charles University, Prague, to register automatically current-voltage curves during the electrolysis of solutions, using a cathode of dropping mercury.

By the aid of this apparatus, Heyrovský and his collaborators have made a series of investigations on 'polarographic analysis'. The method has not only been used in studying the deposition of metals from solutions of their salts but has also found application in elucidating some minor problems in such widely separated fields as biology (lymph and cutaneous diseases), sugar and petroleum technology and pharmacology.

In his very informative Italian monograph, Dr. Semerano describes the apparatus and its uses in the determination of deposition potentials, etc. He discusses the significance of the current maxima observed in certain circumstances and also gives an account of the applications of the method. More than a hundred papers on polarographic researches are cited in the bibliography.

The Map of England: or About England with an Ordnance Map. By Col. Sir Charles Close. Pp. x+166+8 plates. (London: Peter Davies, Ltd., 1932.) 6*s.* net.

To all who use Ordnance maps in the field this book should prove most attractive and full of indications for further exploration of the countryside. Broadly speaking, it consists of three parts. First comes a historical sketch of the mapping of Great Britain and the origin and growth of the Ordnance Survey. Next comes instruction in the reading of a map, which should enable many users of the map to find much more in it than they knew was there; and lastly, there are several chapters on the archæology of maps as expressed in place names, ancient buildings, fortifications, etc. These chapters are exceptionally interesting. The book is illustrated with a few photographs and reproductions of maps and there are useful bibliographical references to each chapter.

Phenomenal Regression to the Real Object

By DR. ROBERT H. THOULESS, Department of Psychology, University of Glasgow

FECHNER's law, that sensation intensity is proportional to the logarithm of the intensity of the stimulus divided by its absolute threshold value ($E=k\log(R/R_0)$) presupposes that there is a single sensation intensity for every stimulus strength. This is true not only of Fechner's law but also of any alternative law of the general form $E=f(R)$. Such invariable correspondence is only found, however, under artificially simplified conditions of perception. Under other conditions, it may break down at either of two points in the total process of perceiving: external stimulus → peripheral physiological process → central physiological process → phenomenon (that is, what is experienced).

A breakdown of correspondence between external stimulus and peripheral physiological process (that is, a condition in which a single intensity of stimulation does not provoke a single intensity of response in the sense organ) is to be found in the facts of contrast. In these, the intensity of the sense-organ's response is determined partly by the intensities of surrounding and of preceding stimuli. If, for example, two identical pieces of grey paper are seen against a white and a black background respectively, then the one on the white background seems the darker. That this is a change in the peripheral physiological process and not (as was once supposed) merely in the phenomenon, is shown by the fact that even in the after-sensation the difference persists; the after-sensation of the grey on the white background appears brighter than that of the other even when the after-sensations of the backgrounds are not themselves visible. Any assertion of a quantitative relationship between sensation and stimulus must, therefore, be stated for a definite condition of spatial and temporal background, since it is a theoretical possibility that a relationship determined for one condition of background may not hold for another.

Another set of conditions disturbing this relationship is universally present in ordinary everyday perceiving, although it may generally be eliminated from a laboratory experiment. Hering found that if a white paper was placed so much farther from a window than a grey paper that it reflected less light to the eye than the grey, it might nevertheless still appear brighter than the grey[1]. Here the breakdown in correspondence between stimulus and sensation proves to be between the peripheral physiological process and the resulting phenomenon. It is found that the after-sensations are equally bright when the illumination of the two papers is adjusted so that they reflect equal intensities of light to the eye, although the appearance of the papers is then of unequal brightness. Since the after-sensation is itself purely determined by the nature of the peripheral physiological process, it follows that (unlike the case of contrast) equal external stimuli are now producing equal retinal processes and the inequality of the resulting phenomena is introduced at a further stage of the perceptual process. Whether this is between the peripheral and the central physiological processes, or between the central processes and the resulting phenomena, there is, of course, no experimental method of finding out.

An extensive quantitative investigation of this tendency has been made by Katz[2], and Köhler has discovered that the reactions of hens and of chimpanzees show its effect[3]. The name originated by the German investigators—the tendency to *colour-constancy*—is, however, open to objection. Other experiments do not confirm the existence of any general law that phenomena tend to remain constant under varying stimulus conditions. The essential fact seems rather to be that the relative phenomenal brightness of two illuminated papers of different albedo is not determined solely by their relative luminosities (or the relative luminosities of their retinal images) but also by the 'real' or physical brightnesses of the papers (that is, their relative albedo). Phenomenal brightness is a compromise between stimulus brightness and 'real' brightness (albedo).

This principle is found to be widely true in visual perception, applying to the seen shapes of objects inclined at an angle to the observer, to the seen sizes of objects at different distances, to the degree of convergence of parallel-sided objects pointing from the observer, and to the colours of objects under different illuminations. A circle, for example, inclined at an angle to the observer is seen not as the ellipse which is its perspective projection (and also its retinal projection) but as a much wider ellipse which is a compromise between this stimulus shape and the real shape of the object[4]. Similarly, if two different sized objects are observed at different distances such that their apparent sizes are equal, this is not when they are making equal retinal images but when the retinal image of the actually smaller and nearer object is very much greater in size than that of the farther and larger object. Seen size is thus also a compromise between stimulus size and the real size of the object observed. These facts may be summarised as a tendency of phenomenal characters of objects visually perceived to regress from the characters given in peripheral stimulation towards the 'real' or physical characters of the object observed.

These effects can be much reduced or altogether eliminated by so simplifying the conditions of perception as to eliminate the perceptual cues to the real character of the object: by partially closing the eyes, completely closing one eye, or (still more effectively) by looking with one eye through a blackened tube cutting out surrounding objects. They return, however, when the ordinary method of perception is resumed. The results of these observations may be summed up in the form of a law: *When a stimulus which by itself would give rise to a certain phenomenal character is presented together with perceptual cues which indicate the physical character of the object, the resulting phenomenal character is neither that indicated by the stimulus alone nor that indicated by these perceptual cues, but is a compromise between them.*

The tendency to phenomenal regression may be most simply demonstrated to a person unfamiliar with it in the following way. He observes an elliptical object such as an elliptical table top with its long axis pointing towards the axis of his body. With both eyes fully open, he then adjusts the height of his head until the apparent shape of the object is circular. Then, keeping his head in the same position, he determines the perspective shape of the object by the usual method of closing one eye and measuring the projected short and long diameters by means of a pencil held out at arm's length at right angles to the line of vision. He finds that this projected shape is a very much flattened ellipse. The circular shape seen is a compromise between the flattened ellipse of the retinal projection and the elongated ellipse which is the real shape of the object.

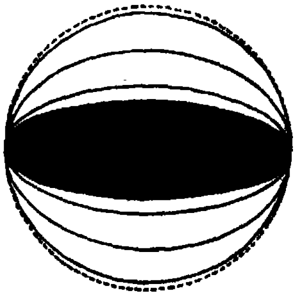

FIG. 1.—Phenomenal regression of inclined circle (median and extreme values for a group of 105 adult subjects).

The testing of a large number of subjects (nearly two hundred) has shown that these effects are to be found in all[5]. In no case was the phenomenon experienced identical with the stimulus character but always a compromise between this and the real character of the observed object. The amount of this dependence on the real object showed very wide individual differences. The extent of these differences is shown in Fig. 1 for an experiment on the perception of an inclined circle. The black inner figure is the plane projection of the circle at the angle of inclination at which it was observed. The central continuous elliptical line shows the average seen shape for the whole group of subjects, while the other two continuous lines show the extreme values of the seen shape for the subject who saw it nearest to the stimulus shape and to the real (circular) shape respectively.

The intercorrelations of the amount of this tendency to phenomenal regression in the perception of size, of shape, and of whiteness show that it behaves as a unitary mental function; the subject who sees close to the real character in one of these respects will tend also to see close to the real character in others. A large tendency to phenomenal regression amongst Eastern races may be an explanation of the absence of perspective and of shadows in Oriental art. The fact that a group of Indian students showed a significantly greater tendency to phenomenal regression than a control group of British students lends likelihood to this explanation.

In studying such facts as these, we are clearly outside that region of facts of sensory physiology for which alone Fechner's law has been stated. We are not, however, outside the region of legitimate quantitative experimental study, although we must not here expect to find simple quantitative laws of universal validity. The phenomenal fact which is not a fact of peripheral physiological process may reasonably be presumed to be a fact of central (cortical) physiology. Since, however, such cortical physiological processes are not at present open to direct study, these facts must be approached through a study of phenomena (that is, by the psychological method).

We may consider briefly a few of the practical applications of these principles. They have some bearing on the effectiveness of certain optical instruments. The usefulness of an astronomical telescope depends solely on its stimulus magnification. This, however, is not the case with a small pocket telescope bought, let us say, for looking at birds. The buyer wants the birds to look big so that they may seem near and lifelike. Mere peripheral magnification that does not attain this object is relatively ineffective. While a telescope magnifies the retinal image, it also diminishes phenomenal regression by introducing the condition of monocular observation through a blackened tube. The effect of phenomenal regression is apparently to make a distant object look larger and a near object look smaller. Elimination of phenomenal regression, therefore, reduces the apparent size of a far object, thus introducing a psychological factor antagonistic to the effect of magnification. So effective may this factor be, that, for a telescope of low power (as ×2), there may be no appreciable apparent magnification in ordinary use, although there is obvious reduction of apparent size if one looks through the wrong end. With higher powers, phenomenal magnification falls considerably short of retinal magnification for the same reason. The ordinary user may, therefore, find more satisfaction in the use of binoculars of relatively low power, since their wider field of view and the presence of distance cues through retinal disparation causes less elimination of phenomenal regression and so fuller psychical advantage from the magnification of the retinal image.

Another practical application of this principle is to be found in the projection of pictures. It has been said that the present television apparatus cannot be expected to give much satisfaction to the observer since the image is far too small—about four inches square. I have, however, several times measured the angle subtended by a cinema screen when at a distance at which the picture was quite as large as was necessary to appear life-like (to have gone much nearer would have made the screen look too big). Yet the side of the screen proved to be subtending an angle little more than half of that subtended by a square of four inch side if viewed from the ordinary distance for comfortable observation of ten inches. Obviously, therefore, it is not a defect of retinal size that makes the television picture ineffective. Phenomenal regression, which helps the distant cinema picture to look large, makes the near television picture look too small. The stray light in a cinema theatre which makes it possible to see the screen as a definite object at a definite distance, is serviceable to effective reproduction both by increasing apparent size and by resisting the tendency to distortion for people sitting somewhat to one side of the screen. For the near television picture this definiteness of location is a disadvantage, and it may safely be guessed that the television picture would gain in effectiveness if it were viewed monocularly inside a box totally black inside, although a cinema picture would lose in effectiveness and apparent size by such a condition of viewing.

[1] Hering, E., "Grundzüge der Lehre vom Lichtsinn", 1905.

[2] Katz, D., "Die Erscheinungsweisen der Farben", Leipzig, 1911.

[3] Köhler, W., "Aus der Anthropoidenstation auf Teneriffa" (2), *Abh. Kön. Preuss. Akad. Wiss., Phys.-Math.*, 1915.

[4] Thouless, R. H., "Phenomenal Regression to the 'Real' Object" (1), *Brit. J. Psych.*, 1931.

[5] Thouless, R. H., "Individual Differences in Phenomenal Regression", *Brit. J. Psych.*, 1932.

Raman Spectra and Chemistry

WHEN a transparent substance is illuminated, a small fraction of the light is always scattered at right angles to the direction of the beam without undergoing a change in frequency, a phenomenon which is known as 'Rayleigh scattering'. In 1928, Sir C. V. Raman, who at the time was investigating the scattering of light by liquids, actually photographed the spectrum of the scattered light for benzene and similar substances when illuminated with a beam of monochromatic light, and found a number of new lines of low intensity, in addition to scattered light of unchanged wave-length (which represented normal Rayleigh scattering by the liquid). These new lines in the spectrum differed in frequency from the monochromatic light used by amounts which were characteristic of the scattering liquid, but were independent of the actual frequency used to excite them. This phenomenon is known as the 'Raman effect', and the new lines are termed the Raman lines of the substance, which we now know may be either a solid, a liquid, or a gas.

The significance of Raman spectra in chemistry formed the subject of a discussion held by the Chemical Society on February 16, which was opened by Dr. J. J. Fox. The field is one which has expanded enormously since Raman's original investigations, and has yielded results of great value both to physics and to chemistry. In the present article the chemist's point of view has been stressed, both in describing the cause of the Raman effect, and also in reviewing some of its possible applications.

The origin of the Raman effect is well illustrated by regarding the light incident on the scattering medium as a 'photon' of energy $h\nu_1$, where h is the Planck constant, and ν_1 is the frequency of the light. This photon may be considered as interacting with a molecule of the scattering substance, and as losing a part of its energy. As a result, the scattered light will have a lower energy $h\nu_2$, and its spectrum will contain a new line of frequency ν_2, which will be one of the Raman lines of the scattering substance. An amount of energy $h(\nu_1-\nu_2)$ must have gone to increase the energy of vibration or rotation of the molecule with which the photon collided. We know that this is what has happened, because of the close correspondence between the Raman frequency displacements $(\nu_1-\nu_2)$ and the rotational and vibrational frequencies of molecules, as deduced from infra-red absorption spectra. It is also possible for ν_2 to be greater than ν_1, if the photon can absorb energy from the molecule instead of imparting it. This 'anti-Stokes' scattering is less frequent than the normal Raman effect.

It is important to distinguish between the Raman effect and fluorescence, which results from the absorption of light energy, followed by a re-emission of radiation of a lower frequency, characteristic of the absorbing substance. For the production of fluorescence the exciting frequency must be greater than a minimum threshold value, and the fluorescent radiation will be of a fixed frequency if this criterion is satisfied. Fluorescence is of relatively rare occurrence, and is perhaps best known for solutions of certain dyes: it is obtained with atoms or molecules, whereas the Raman effect is observed only with molecules.

The correspondence between Raman frequencies and infra-red absorption spectra is well illustrated in the case of hydrogen chloride, which has an infra-red absorption band with its centre at 3·46μ. Wood found that hydrogen chloride has a Raman line with a frequency displacement of 2886 cm.$^{-1}$ (that is, 2886 wave numbers, this being a measure of the light frequency in terms of the number of waves per centimetre). This frequency corresponds with a wave displacement of 3·465μ, which is in exact agreement with the position of the centre of the infra-red absorption band. This result means that the Raman line in hydrogen chloride is due to the absorption of energy by the molecule, and its utilisation to increase the vibrational energy of the two atoms along the line joining them, without change in the rotational energy. Liquid hydrogen, on the other hand, shows Raman displacements of 354 cm.$^{-1}$ and

588 cm.$^{-1}$, and these two values agree closely with rotational frequencies of the hydrogen molecule, as deduced from the study of band spectra. In this case it is the rotational energy of the molecule which is increased. Non-polar molecules do not absorb light in the infra-red, but nevertheless, may show the Raman effect, which is of special use in such cases in calculating moments of inertia of the molecules and the distance between nuclei.

The Raman effect is generally investigated by using the mercury arc as a light source, one or more of the stronger lines being isolated by the use of light filters. The substance to be examined is then illuminated as intensely as possible, and the light scattered at right angles to the direction of illumination is examined with a large aperture spectrograph. The amount of scattered light is generally extremely small, and exposures of up to fifty hours are often needed to obtain satisfactory photographs of its spectrum. Numerous special types of apparatus have been devised, as, for example, in the examination of liquefied gases by McLennan, or in the study of single crystals. Many substances have been examined in solution, as the Raman spectra of solvent and solute will generally be superposed. Temperature changes have little effect, unless the molecular weight changes with the temperature, in which case it may be possible to observe lines characteristic of the simple and of the more complex molecules (for example, sulphur and sulphur trioxide). The effect of the physical state is also small in most cases, liquid water, ice, and water in the form of water of crystallisation, for example, showing almost the same Raman spectra.

From the large amount of experimental results already collected, it is possible to correlate certain definite Raman displacements with the existence of a particular vibrating group in a number of different molecules. Thus a Raman frequency of about 2900 cm.$^{-1}$ is observed (among other lines) for a large number of organic molecules such as CH_4, CH_3OH, and C_6H_6, and has been definitely associated with the vibration of a C—H linkage. Similarly, the C=O linkage is characterised by a Raman displacement of 1710 cm.$^{-1}$ in all ketones, and of 1730 cm.$^{-1}$ in esters, whilst a double bond between two carbon atoms always gives rise to a frequency of about 1600 cm.$^{-1}$. These frequencies undergo small but definite variations according to the nature of the rest of the molecule. Dr. Fox illustrated this in the case of the benzene frequency of 1600 cm.$^{-1}$, which undergoes a gradual decrease in the chlorine derivatives as the molecule becomes heavier, as shown below:

C_6H_6	C_6H_5Cl	$C_6H_4Cl_2$	$C_6H_3Cl_3$	$C_6H_2Cl_4$	C_6HCl_5	C_6Cl_6
1584	1580	1572	1560	1558	1553	1510 cm.$^{-1}$

This frequency has been attributed by Andrews[1] to the stretching of double bonds in the Kekulé benzene model. The Raman frequency will, in general, be between 2600 cm.$^{-1}$ and 4000 cm.$^{-1}$ if the vibrating pair is of the type X—H, less than 1200 cm.$^{-1}$ for X—X, 1200—1800 cm.$^{-1}$ for X=X, and 1800—2600 cm.$^{-1}$ for X≡X. These facts enable us to decide the structure of gaseous carbon monoxide, which has a Raman shift of 2155 cm.$^{-1}$, indicating a triple bond, and not a double bond of the ketone or ester type. A recent communication to NATURE directed attention to the Raman spectrum of nickel carbonyl, in which the triple bond frequency for the carbon—oxygen linkage was shown to persist.[2] Organic nitriles (R.C≡N) and isonitriles (of the type RN≡C) show Raman displacements of about 2250 cm.$^{-1}$ and 2160 cm.$^{-1}$ respectively, but hydrocyanic acid shows two frequencies at 2062 cm.$^{-1}$ and 2094 cm.$^{-1}$, the first of which may be attributed to a molecule HN≡C and the second to the tautomeric form HC≡N. The Raman spectrum of acetoacetic ester shows even more clearly the existence of the two tautomeric forms, since the ketone and the ester C=O frequencies (indicating the formula $CH_3\overset{\overset{\displaystyle O}{\|}}{C}.CH_2.COOC_2H_5$), and also the C=C and the OH frequencies (indicating a formula $CH_3.\overset{\overset{\displaystyle OH}{|}}{C}=CH.COOC_2H_5$) are observed.

$CH_3\overset{\overset{\displaystyle O}{\|}}{C}.CH_2.COOC_2H_5$

$CH_3.\overset{\overset{\displaystyle OH}{|}}{C}=CH.COOC_2H_5$

An interesting study of the ionisation of nitric acid has been made by Rao.[3] At a concentration of more than 65 per cent, the acid shows a Raman line at about 1300 cm.$^{-1}$, due to the NO_2 group, which is also observed in nitrites, nitrobenzene, nitromethane, and similar compounds. Only on dilution is the line at 1050 cm.$^{-1}$, which is characteristic of the NO_3 ion in solutions or in crystalline nitrates, observed. This would indicate that the strong acid has the formula NO_2OH, a fact which harmonises with its nitrating action on organic compounds. Rao has claimed that the intensity of the line due to the NO_3 ion may be used as an approximate measure of the degree of ionisation of the acid. A similar phenomenon is observed with sulphuric acid. The acid of strength above 25 per cent shows a line at 1046 cm.$^{-1}$, which is attributed to the (HSO_4) ion, since it appears prominently in solutions of potassium hydrogen sulphate $(KHSO_4)$. At concentrations less than 25 per cent, a Raman line due to the $(SO_4)''$ ion makes its appearance. It is observed in solutions of sulphates, irrespective of the cation, and also in crystalline sulphates.

Dadieu and Kohlrausch have used the vibrational Raman frequencies, which may, in many cases, be associated with interatomic linkages in molecules, as a means of calculating the strength of binding of the two atoms. By treating the vibrating pair as a simple harmonic oscillator, it is possible to calculate the restoring force per unit displacement. The amplitude of the oscillation may also be derived, the product of these two quantities measuring the binding force. As calculated by this method, the strength of single, double, and triple chemical bonds are in the ratio 1 : 2 : 3. It is possible to calculate absolute values of the strength of linkage from the relative values, if some one absolute value is known (for example, for the C—H linkage in the benzene ring, a value of 101,000 cal. per gram molecule may be used).

The discovery of the Raman effect is so recent that it is not surprising to find that theory has lagged behind experiment. Raman spectra may often be photographed with relative ease, but up to the present, the results have only been interpreted fully in the case of some of the simpler molecules, of which carbon tetrachloride may be taken as an example. Very careful examination of the Raman effect for substances of this type, and particularly, intensity and polarisation measurements for the individual Raman lines, makes it possible to determine all of the fundamental vibrations in the molecule. This problem becomes more and more difficult as the molecule increases in complexity, but there can be little doubt that, in time, the subject will develop to a point where the chemist will be able to consider the molecule as a dynamic rather than a static system. In the meantime, we may anticipate that the accumulation of Raman spectrum data will continue, and that they will be applied to solve many problems of molecular constitution.

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[1] *Phys. Rev.*, 36, 537; 1930.
[2] NATURE, 130, 1002, Dec. 31, 1932.
[3] *Proc. Roy. Soc.*, A, 127, 279; 1930.

Obituary

PROF. PAOLO ENRIQUES

PAOLO ENRIQUES, who died on December 26, had held the chair of zoology and comparative anatomy at the University of Padua since 1921, and was the leader of Italian zoologists along the lines of genetic, physiological, and philosophical research. Born at Leghorn on August 17, 1878, he pursued his university studies at Florence, Rome, and Bologna, devoting four years to medicine, in which he qualified at Göttingen, and two to natural science, in which he took the doctor's degree at Bologna in 1901. In the following years he lectured at Florence on the philosophical approach to biology, at Sassari in medicine and later on comparative anatomy. While professor at Padua he also taught under the Faculty of Medicine in the Schools of Pharmacy and of Social Science, and for some years lectured on genetics applied to the breeding of silkworms at the Silkworm Station of Brusegana.

Besides a number of papers on various organs of Mollusca in their functional aspect, on reproduction in Protozoa, on the nucleus of Radiolaria, and similar subjects, Prof. Enriques published several works of wider scope. That which shows most clearly his critical and constructive thought is "La Teoria Cellulare" (Bologna, 1911), in which he attempted a synthesis of modern biological problems. In "Eredita nell' uomo" (1922) he brought to bear on the subject his medical knowledge of pathological characters, while in "Riproduzione dei Protozoi" (1922) he resumed the researches of himself and his pupils, which led to conclusions of fundamental importance, particularly regarding the biological cycle of the Infusoria. His "Trattato di Zoologia e di Anatomia Comparata" has been adopted in many Italian and some foreign universities. In a monograph on Mendel's laws and chromosomes, Enriques summarised the researches of the previous fifty years, and deduced from them new laws, adding to the three classic laws of Mendel a fourth law of independent variability based on his study of variability in radiolarian species, as well as various synthetic statements of the phenomena associated with sex and sex-linked characters. In 1928 he communicated to the Istituto Veneto his "Teoria della Ciclogenesi", in which the difference between plants and animals was set on a new basis.

In a recent series of six "Contributi alla Teoria dell' Evoluzione" Enriques urged that heredity and evolution are not irreconcilable facts but that the phenomena are explicable by his fourth law of heredity. Not many months ago there appeared the three volumes of *Atti* of the eleventh International Congress of Zoology, to editing which he had devoted all his energies; they contain 1,500 pages and 38 plates. Herein are published summaries of some of his previous studies, as well as a proposed classification of Radiolaria. This last anticipates the classification to be followed in his monograph on the Radiolaria of the Gulf of Naples, a great work unfortunately left incomplete. Other books now in press are a translation of "The Biological Basis of Human Nature" by Jennings, and "Il problema della Vita" which purports to give in intelligible language a synthetic review of all the problems of biology considered in their manifold aspects—physical, chemical, morphological, and philosophical.

The value of Enriques' work was widely recognised: he presided over both the Unione Zoologica Italiana and the Accademia Scientifica Veneto-Trentino-Istriana from 1928 until 1930; he was honorary vice-president of the International Congress of Genetics at Ithaca, United States, and president of the International Zoological Congress at Padua in 1930. There one saw the magnificent Institute of Zoology that had just been completed under his direction, and there the representative of Great Britain had abundant opportunities of appreciating his powers of oratory, his clarity of exposition, his originality of thought, and, beyond these, his friendly hospitality, his goodness of heart, and his devotion to the highest ideals of science.

The academic term was over; Enriques had started in his motor-car for Naples to continue his researches on Radiolaria; he was alone on the road that led across the Campagna, when an accident overturned his car; he was picked up and taken back to Rome, where he lay in hospital for a week; his recovery was looked for, but on Christmas Day, meningitis supervened, and he died on December 26. Thus all too early have Italy and the world lost one who, to adapt his own words, exhibited "un temperamento passionale che si affigge in una idea grande e la persegue con ricerche e scoperte, o grandi o piccole secondo le sue forze, ma sempre avendo dinanzi la spiegazione generale e profonda della natura". F. A. B.

SIR DANIEL MORRIS, K.C.M.G.

THE death of Sir Daniel Morris, in his eighty-ninth year, brings to a close a long life devoted to the public service; but it is his work for the Empire, as Imperial Commissioner of Agriculture in the West Indies, that will be kept especially in grateful remembrance.

Except for the twelve years (1886–1898), when he was assistant director at Kew, under Sir William Thiselton-Dyer, Morris's work and interests had lain overseas in the Colonies, and while he held the assistant-directorship he was seconded to undertake a special mission to the West Indies (1890–91), in connexion with the development of the fibre, sugar and banana industries in particular; again, in 1895, he visited the Bahamas and the following year he was appointed expert adviser to the commissioners on agricultural and botanical questions, when the West Indian Royal Commission was sent out during Mr. Chamberlain's fruitful time at the Colonial Office. His valuable services were very fittingly recognised by his appointment as Imperial Commissioner of Agriculture in 1898. During the ten years he occupied this important post, he enlisted the services of a staff of experts to teach and advise in the Leeward and Windward Islands, and was able to bring about co-operation between the various islands and develop their agricultural industries on sound lines.

Among other valuable undertakings Morris's personal introduction of Sea Island cotton to the Islands was a signal achievement; to him also is due the improvement of the sugar cane by hybridisation, and the extension of the cultivation of limes and *Cacao* and other tropical products. The inter-colonial agricultural conferences which he established have done much good work, mainly in bringing together the agricultural officers and planters in the Islands and so helping to co-ordinate and stimulate their efforts.

Morris received the honour of the C.M.G., in 1893 "in recognition of Scientific and Economic Services rendered to Her Majesty's Colonies", and in 1903 he was advanced to K.C.M.G.

Before Morris went to Kew in 1886, he spent two years in Ceylon (1877–79), working on the coffee disease as assistant to Dr. Thwaites, and from there he was promoted to be director of Public Gardens and Plantations, Jamaica, a post he held for seven years. While holding this post he visited British Honduras, in 1882, and St. Helena in 1883. His report on the economic possibilities of St. Helena is a valuable document which, had it been followed up in practice, would have been of great benefit to the island.

While at Kew, Morris was treasurer of the Royal Horticultural Society from 1888 until 1891, and took an active part in the affairs of the Society at a critical time. He was enrolled a Victoria medallist of the Society and for many years was one of the vice-presidents.

Since his retirement Sir Daniel Morris was, until his health began to fail, an active member of the governing bodies of the Imperial Institutes of Entomology and Mycology, and of the John Innes Horticultural Institution. In Bournemouth, where he settled on his return home from the West Indies, he quickly entered into the scientific life of the community, and the present flourishing condition of the Bournemouth Natural Science Society is largely due to his keen and stimulating interest.

Morris's published papers deal mainly with botanical or agricultural matters of economic importance and are valuable works of reference. Very possibly much of the good work he was able to carry out was due to his skill as a speaker, for he was a lecturer as well as a writer of unusual ability. Lady Morris, who was his able ally for more than fifty-two years, died in January of last year.

DR. JOHN R. FREEMAN

FROM *Earthquake Notes* for December 1932, issued by the Eastern Section of the Seismological Society of America, we learn of the death of Dr. John R. Freeman on October 6, 1932.

Dr. Freeman was consulting engineer to several important engineering concerns in the United States. He was president of the American Society of Mechanical Engineers in 1904 and of the Society of Civil Engineers in 1921. He did much work in connexion with water engineering and fire protection. Dr. Freeman studied earthquakes from the engineer's point of view. His principal works are his detailed study of the Melfi (Italy) earthquake of July 23, 1930, and his great book on "Earthquake Damage and Earthquake Insurance", published last year, in which he made valuable contributions to the problem of earthquake insurance in the United States.

WE regret to announce the following deaths:

Prof. T. Alexander, formerly professor of engineering at Trinity College, Dublin, on February 17, aged eighty-five years.

Lord Lovat, K.T., G.C.V.O., K.C.M.G., formerly chairman of the Forestry Commission, who has done much work in connexion with the development of forestry throughout the British Empire, on February 18, aged sixty-one years.

Dr. A. D. Risteen, director of technical research in the Travelers Insurance Co., known for his work on industrial technology and safety, on December 30, aged sixty-six years.

Dr. John Watts, of the old Chemistry Department of the University of Oxford, author of memoirs on the industrial uses of tannins, on February 9, aged eighty-nine years.

News and Views

Christ's Hospital and Samuel Pepys

REFERENCE was made in the article on Pepys in NATURE of February 18 to his association with the Royal Mathematical School of Christ's Hospital, and the circumstances attending the foundation of the School are worth recalling. The project for a naval seminary, communicated to Charles II for his approval, was backed, in the first instance, by Sir Robert Clayton, Sir Jonas Moore, and Sir Christopher Wren; afterwards they were materially assisted by Pepys. Sir Jonas Moore was Surveyor General of the Ordnance and he solicited the favour of the Duke of York, then Lord High Admiral. A royal charter was granted and the School was opened in 1673 for forty boys. Little was done, however, by King Charles towards its maintenance, and the foundation suffered many vicissitudes. Pepys offered various objections from time to time to what he deemed inefficient methods of administration and teaching, and when, in 1698, he was appointed vice-president, he turned his attention to the re-modelling of the Mathematical School. The following is an extract from a letter of Pepys to the governors, dated May 4, 1694:—". . . when, in the yeare 1676 a shipp of the King's (with another of certain private adventurers) design'd upon an Expedition for Discovery of a passage by the N.E. to China; wherein his then majesty had reason to expect many unusual occurrences, and therefore fit for a Child of this Foundation to share in the first advantage of: He was pleased to communicate his pleasure in it to the Hospital. In which, provision was made for the child's being not only well instructed in his service during the voyage . . . but returned at the end of it; as he accordingly was, and by us afterwards bound apprentice to a Merchant Man, Bartholomew Clement, Master of the Ffortune, tradeing to Virginia". In April 1699, Pepys was presented with the freedom of the City of London "in acknowledgment of the great zeal and concern for the interest of Christ's Hospital which he hath manifested on all occasions".

The Marquis of Worcester at Vauxhall

AMONG those pioneers of the use of steam for pumping who have found a place in engineering history is Edward Somerset, second Marquis of Worcester (1601–67), whose life was written in 1865 by the civil engineer, Henry Dircks (1806–73). The Marquis lived in troubled times but all his life was interested in mechanics, and in 1663 published his "Century of Inventions", containing notes in vague and mysterious language on inventions to be tried and perfected. Quite early in life, with the German master mechanic, Caspar Kaltoff, he became connected with the Ordnance Factory founded by Charles I at Vauxhall and on this site later in life he proposed to found a college for training artisans, and erected his famous 'water commanding engine', which attracted considerable attention. The interest surrounding the projects and achievements of the Marquis led Mr. W. H. Thorpe to attempt to determine the exact site of the works at Vauxhall, and in a paper read to the Newcomen Society on February 15, he gave an account of his researches and their results. The position of the property was, he said, indicated by a petition dated 1666 presented to Charles II by the Marquis, and the details of the property are described in a report made by the Surveyor General to the Duchy of Cornwall. Further evidence was obtained from Rocque's large-scale "Survey of London" made in 1739–45. For a description of the apparatus for pumping erected at Vauxhall, we are indebted to two foreigners who saw it, but neither of them refers to the use of steam. One of the notes in the "Century", however, refers to "an admirable and most forcible way to drive up water by fire", and it is this that gives the Marquis of Worcester his place among pioneers of the steam engine.

Industry and Electrical Research

THE twelfth annual report of the British Electrical and Allied Industries Association (E.R.A.) presented at the annual luncheon on February 15 is satisfactory and interesting. A period of depression in commerce often means greater activity in development. The report shows that there are seventy-seven committees actively engaged in advising and directing research on problems of urgent importance to industry. An incidental advantage is the benefit that accrues to individuals who share in the constant exchange of views which takes place at these specialist committee meetings. At the start, the organisation was almost entirely based on the sections of the industry connected with manufacturing. Its activities have now widened very much and there are very few electrotechnical problems outside its sphere. The Association was never designed to relieve manufacturing works of the necessity of solving their own specific problems. The report proves that many of the subjects considered interest several branches of the industry. The financial statement shows that the main contributions, so far as money is concerned, now come from the electric supply companies, railway groups, etc. Although the actual income for last year was greater than the preceding year, yet the Association has adopted a conservative policy, maintaining its organisation intact, expediting the completion of researches and advancing the plans for new work. Many members of the permanent staff have been engaged solely in scientific investigations and the reports they have published have been useful to the industry.

MATERIAL progress has been made during the year towards ascertaining the real properties of dielectrics, as distinct from empirical measurements of their behaviour under given conditions. Numerous commercial problems are under investigation, as, for example, the study of radio condensers in co-operation with the British Broadcasting Corporation. Improved efficiencies in steam generating plant have been effected mainly by a better knowledge of the properties of steam and studies on the creep of metals. Important conclusions have been arrived at by researches on wind pressure on overhead lines, heating of buried cables and cables in ducts, the armouring of cables and methods of efficient earthing. The work done on the design and use of concrete poles may lead the Electricity Commissioners to reconsider the present stringent regulations relating to their use. Important advances have been made in new types of switches to break large currents at high voltages. We are now abreast of the work done in competing countries and in some directions we are in advance. Thanks to experimental research and advanced mathematical calculations, the problem of the interference caused by power circuits on communication circuits can now be regarded as solved. Good progress has been made in the study of problems of importance in railway engineering. The printed schedule of headings under which the railway researches are being conducted now runs to twenty pages.

Training the University Graduate

IN the annual report presented by the Vice-Chancellor, Sir Charles Grant Robertson, to the court of governors of the University of Birmingham on February 23 comment is made on the increase in the number of students in spite of the general depression. It is pointed out that on the Continent, the universities are greatly congested, the attendances being, paradoxically, greater the greater the depression. The chief increase is in the faculty of medicine. The Vice-Chancellor raises the question whether the universities are doing all that they might or ought to do to meet the requirements of the rapidly changing social conditions. For example: "if the Universities are providing, and will have to provide to an increasing extent, direct training for careers, not contemplated twenty years ago, and those careers require a special technique, the essential problem is as to whether that technique can be *taught*, or whether the true function of the University lies in preparing for the most rapid acquisition of the technique elsewhere and as a post-graduate business. 'Technocracy' is the latest American gift, and we may fear the United States—especially as a giver—but do we not need as a nation, *outside* the Universities but definitely correlated to them, a series of 'schools' which will do for the University graduate, who has not been like the engineer technologically trained, what the Hospital does for the medical graduate who becomes, for a strictly limited period, a House Physician and a House Surgeon? Do we not also need a much closer connexion between the big Technical Colleges and Schools and the Universities?" In referring to the report of the Joint Standing Committee on Research, the Vice-Chancellor gives his opinion that "the Committee ought to be in a position to support a plan of research conducted *by a Department* as a whole on definite lines and for a definite purpose and extending over a defined period". The only obstacle to such a policy is of course the financial one.

Specialist Posts in Industrial Management

AN article by Dr. W. H. Coates in the January number of the *Journal of Careers* reviews the developments in industry which have led to the creation of specialised posts in industrial management. These developments are the outcome of the changed conditions of industry and the heavier demands upon human qualities in management which are made by the growth of the scale of industrial enterprise and organisation. Where formerly several men filled one function in several small businesses, there are now several men each specialising in one function in large-scale business. These specialised activities can be broadly classified as they are concerned with production, sales or administration. We thus have the new key positions such as planning and production manager, transport manager, sales manager, secretary, personnel manager, labour officer, purchasing officer, etc. Specialisation in this way, concentration of research, thought, and practice within a limited field, is steadily leading to more efficient management, to fuller knowledge and to new ideas, and affords also a way of applying the scientific method to an increasing extent to the problems of administrative and executive control. Dr. Coates visualises alike a large field in which scientific methods have to be applied with an accuracy, patience and persistence comparable with those applied in the fields of physical science, and a field of human co-operation which makes large demands upon team work if the problems of large-scale industrial management are to be solved. Given such conditions, Dr. Coates sees no limits to successful management implicit in the size of the undertaking, and is confident that there is no lack of young men who are capable of tackling the present and future problems of large-scale management.

Fat in Æstivating Animals

IT is a matter of common knowledge that many hibernating animals, in cold climates, survive their long and enforced fast by accumulating fat within the body, or immediately under the skin. It is by no means so generally realised that a precisely similar accumulation is made by many animals living in hot climates, which must also fast, in a state of æstivation, until food is again procurable. A good opportunity of making observations on some æstivating types has just been furnished by the birth at the Gardens of the Zoological Society of London of four 'fat-sand-mice' (*Steatomys*) and four 'fat-tailed gerbils' (*Pachyurus*). For this curious adjustment has now apparently become fixed, since even in captivity the fat is still stored, though its need has disappeared. But there seem to be no records as to whether the amount of fat formed is less in captive animals, which have no need to fast, and at what stage in the growth of the young animal it begins to make its appearance. There seem to be no possible means of discovering why, in these two types, living under precisely similar conditions, one should form a deposit of fat over the greater part of the body, while in the other it should accumulate in the lower part of the back and tail.

Candles and Candlemaking

THE science and art of illumination are nothing if not progressive and the displacement of the candle, emblem of humble domesticity and spiritual occasions, by other forms of light is but one of the inevitable consequences of modern progress. Candle manufacture is casually regarded as a minor industry to-day, but such is actually not the fact as Mr. David Allan showed in his paper on this subject before the Institution of Petroleum Technologists on February 14. The candle has had a firm place in history and religion since ancient times. Its simplicity of construction and self-contained character have commended it for use in diverse circumstances where soft and easy illumination have been required. Essentially a cylinder of fat or wax enveloping a fibrous core or wick, cast in various shapes and sizes, its form has varied but little throughout the ages. Attention latterly has been paid chiefly to efficiency and cheapening of methods of manufacture, while a measure of artistic evolution is discernible in the shapeliness of form and decorative effects achieved in the modern product. The candle industry, in so far as it relates to manufacturing process, is a comparatively straightforward matter, but the technology behind it is by no means so simple. The author has done good service, not only by presenting a comprehensive account of the subject, but also in describing the essential technology. While the petroleum industry cannot claim the candle as entirely its own product, the paper shows clearly that this article of commerce is by no means one of minor importance, and the link between hydrocarbon oils and saponifiable fats and waxes is once again well illustrated by its technical study and description.

Safety of Life from Fire

A USEFUL lecture given by Col. G. Simonds at the Royal Society of Arts on "Safety of Life from Fire" is published in the Society's *Journal* for January 20. The figures given prove that the fire risk to individuals is not large, but as the risk can be almost eliminated by a few simple common-sense rules, it is advisable that they be taught in schools. The best way of doing this is by showing films illustrating the principal dangers and the methods of avoiding them. The dangers to life arise mainly from the products of the fire, namely, smoke and hot gases. During a fire, it is a safe rule never to open a door if a fire is raging the other side. If it is necessary, and the door opens towards you, one hand should be placed on the handle and the other shoulder high on the door. The door can then be opened safely about three inches, the opener being protected from the smoke and gases and so see something of the surroundings. If necessary, the door can be shut quite easily. To go through smoke one should crawl on the hands and knees keeping the mouth as close to the floor as possible. When coming down a staircase through fire or smoke one should keep as close to the wall as possible and if it is necessary to crawl, come down feet first. A person whose clothes are on fire should never be allowed to remain standing for a moment. Fatalities nearly always arise from the shock of burning about the face and head. If they should start to run they should be tripped up and rolled on the floor in a coat or a blanket if possible. The new tannic acid treatment for burns has proved very successful, as shown by Dr. Philip H. Mitchiner in his Hunterian lecture delivered before the Royal College of Surgeons on February 1 (*Lancet*, Feb. 4, p. 233). The results of its use show a very decided percentage drop in the number of fatal cases. People should be warned about the dangers of cleaning with petrol as the number of fatalities due to this cause is increasing.

Ultra-Short-Wave Radio Research

Two papers, communicated by the General Electric Co.'s research laboratories at Wembley, were read to the Radio Section of the Institution of Electrical Engineers on January 4 by Mr. E. C. S. Megaw. The first paper gives a critical summary of the existing knowledge of electronic oscillations. The methods of their production are outlined and their applications to radio communication are described. Using these oscillators and parabolic reflectors, Beauvais obtained in 1930 a maximum range of telegraphic transmission of about 25 miles from the top of the Eiffel Tower. In the Dover-Calais demonstrations of the International Telegraph and Telephone Laboratories (March 31, 1931) duplex telephony was achieved over a similar distance. In the second paper, possible methods of utilising magnetrons to generate short-wave oscillations are indicated and the more important of the results obtained by previous workers are described. Experimental investigations were undertaken to discover the relations between electron and dynatron types of oscillation. For electronic oscillations it was found that the experimental results are entirely in agreement with theory in those cases where it is applicable. The investigation of the simple dynatron oscillations showed that the static characteristics exhibited a negative resistance effect. During oscillations it was found that the anode current may exceed the original total emission current. This is considered to be due to the bombardment of the filaments by electrons which return to it with considerable velocity. The shortest wave-length obtained by means of dynatron oscillations was about thirty centimetres. At this wave-length the power attainable was about a tenth of a watt. It is concluded that for wave-lengths less than about fifty centimetres electronic oscillations give the greatest output.

Mortality from Whooping Cough

IN a paper read at a meeting of the Royal Statistical Society on February 21, Dr. Bradford Hill pointed out that, in modern times, mortality from whooping cough in England and Wales has shown a remarkable decline, the death rate in the years 1921–30 being only one-third of that recorded in 1861–70. In spite of this improvement it remains a very important cause of child mortality. In 1921–30 it was responsible in England and Wales for no less than 44,000 deaths, or nearly 1 per cent of the total mortality of the population. The mortality falls mainly upon the first two years of life, while, in 1921–30, more than 90 per cent of the deaths were concentrated on the first five years, a ratio which was equally true at the end of the eighteenth century. In view of this concentration upon very young children, steps to control it are earnestly to be desired. One of the most curious anomalies of whooping-cough mortality, which has long been recognised, is the consistently heavier mortality of female children. Various attempts have been made in the past to explain this, for example, in terms of the sex differences in the formation and development of the larynx, sex differences in sensitiveness of the nervous system, but none of the hypotheses so far put forward seems, on careful examination, to be adequate.

Another curious feature of the mortality of infants from whooping cough is the lower death rates of illegitimate infants, when compared with the legitimate, in the first three months of life, while at the same age lower death rates are found in urban districts when compared with rural. An abnormal characteristic of the epidemiology of the disease, that has existed for at least three quarters of a century, is the increasing proportion of early deaths with decreasing urbanisation. This feature of the disease is not shown by measles. The latter acts according to 'expectation', namely, the more the 'overcrowding' the earlier the liability to attack and death. Yet whooping-cough statistics for England and Wales suggest the reverse. The relative importance to-day of whooping cough as a cause of widespread sickness and death is perhaps still under-rated, and further steps to combat it are required.

British Claims in the Antarctic

By an Order in Council dated February 7 and published in the *London Gazette* of February 14, a sector of the antarctic comprising an extent of one hundred and fifteen degrees of longitude and covering more than a quarter of the antarctic continent has been placed under the authority of the Commonwealth of Australia. The *Times* reports the order as stating that "that part of the territory in Antarctic Seas which comprises all the islands and territories other than Adélie Land situated south of the 60th degree of South Latitude and lying between 160° E. and 45° E. is territory over which His Majesty has sovereign rights". The order comes into force when the necessary legislation has been passed by the Commonwealth Parliament. Adélie Land was claimed by France in 1924 but its boundaries were not defined. The new territory adjoins the Ross Dependency of New Zealand on the east and extends from Oates Land through King George, Wilkes, Banzare, Knox, Queen Mary, Wilhelm, and MacRobertson Lands to Enderby Land, beyond which Norwegian discoveries link it to Coats Land. The coasts of most of the territory were discovered by British, including Australian, and American explorers. The glaciated interior is unknown. No one name is in use for the whole of the area. The only commercial value of the coasts is for whaling.

The Shrimp Industry of Leigh-on-Sea

Under this title Mr. A. Laurence Wells has written a long and comprehensive account of this once important industry of the Thames Estuary (*Southend Standard*, Dec. 29, 1932, Jan. 5 and 12, 1933). Unfortunately, shrimping at Leigh has steadily dwindled since the beginning of this century. From six boats in 1832, the numbers rose to a hundred in 1850 and two hundred in 1875, dropping from 1905 to the present time, when there are only sixteen shrimpers among the forty boats engaged in fishing activities. These records of a vanishing industry are well worth preserving and Mr. Wells with the help of the manuscript notes now safely preserved in the Southend Museum made by the late Dr. James Murie gives us a most interesting survey both historical and biological. The term 'shrimp' embraces several species which are all described and differentiated. Thus from this district we have the common 'brown shrimp', the original shrimp of commerce, at first the only kind fished; the 'banded shrimp', the 'yellow shrimp' and the 'channelled shrimp'. Besides these true shrimps there is the 'pink shrimp' which, though not a prawn, is prawn-like, and four species of real prawns. Finally, there is *Nika edulis*, the so-called 'Risso's shrimp' which, although rather rare, is very good to eat. Each of these has its own individual habitat. Their life-histories are different and the fisherman knows a great deal about them which is not known to the general naturalist. There is much valuable information in this series of articles which all interested would do well to study.

Aquaria

The importance of observing the hydrogen ion concentration in the aquarium is now fully recognised. Both the *Aquarist and Pond Keeper* of January–February 1933, and the *Aquarium Review* of December 1932, include articles on this subject ("*PH* Values, Their Meaning and their Significance to the Aquarist", by J. F. Corrigan. "The Aquarium and *p*H" by L. C. Mandeville). The same number of the *Aquarist* contains notes from the Brighton Aquarium by the Curator, Mr. George W. Weller, and notes from the Zoological Society's aquarium by the Director, Mr. E. G. Boulenger. In the Brighton Aquarium there are now living one hundred and twenty herrings; also an angler, *Lophius piscatorius*, which is very difficult to keep alive and one of the most voracious of all fishes. Mr. Lester L. Swift gives a very interesting account of the American tropical fishes belonging to the genus *Mollienesia*, and how to keep and rear them. These fishes are viviparous but somewhat difficult and irregular in breeding in captivity. They require much vegetable food as well as animal, and a certain kind of slimy alga, known as 'frog-spit', is apparently essential to the raising of healthy broods. A female may have 2–10 young every few days for a month or she may have a litter once a year or once a month for several months in succession.

Journal of Chemical Physics

THE first number of the new American *Journal of Chemical Physics*, which is published by the American Institute of Physics and has an editorial board comprising the leading American chemists and physicists, contains a number of important papers. In a brief editorial introduction, Prof. H. C. Urey, the managing editor, states that the journal caters for an increasing number of investigators who are working on subjects on the border-line between physics and chemistry, who have a broad knowledge of both sciences and are using methods of investigation which belong neither to classical chemistry nor to traditional physics. The papers in the new journal, which has an attractive format and is well printed in double-column pages, include contributions by Langmuir on an extension of the phase rule for adsorption, by Debye on the mass of electrolytic ions, by G. N. Lewis on the chemical bond, by Harkins and Jackson on a spectroscopic study of the decomposition and synthesis of organic compounds by electrical discharges, by Pauling on helium molecule ions, and several other important communications on physics and physical chemistry. It is clear that a high standard has been set in the new journal, and although the multiplicity of chemical and physico-chemical journals, especially in Germany and the United States, presents a serious economic problem to scientific institutions, the *Journal of Chemical Physics* should be welcomed as an authoritative medium for the publication of work which is interesting both to chemists and physicists.

World Petroleum Congress

A WORLD Petroleum Congress, organised by the Institution of Petroleum Technologists, is to be held in London on July 19–25. Membership is open to all persons connected with, and interested in, the petroleum industry, at a nominal fee of 10*s*. It is proposed to hold the sessions of the Congress at the Imperial College of Science and Technology, South Kensington, and the scope of activities on this occasion includes the reading of various technical papers, a private view of the International Oil Industry's Exhibition, exhibition of films illustrating the petroleum industry and sundry social arrangements. Foreign delegates from all important oil-producing countries are being invited and the Congress will offer an excellent opportunity for the interchange of ideas, both technical and economical. Broadly speaking, the technical programme will embrace four main sections of the industry, geological, engineering, refining and chemical, and standardisation. From the preliminary announcements available, it would seem that this Congress, by its purpose and very wide appeal, will be one of the most important international functions affecting the petroleum industry which has been held for many years, and it is a matter of gratification that, on this occasion, it has both a British sponsorship and setting.

Atoms, Molecules and the Atmosphere

FOR his presidential address before the Royal Meteorological Society, on February 15, Prof. S. Chapman took as his subject, "Atoms, Molecules and the Atmosphere". While the molecular constitution of air can be ignored in considering most meteorological problems of the lower atmosphere, it is of great importance for the phenomena of the upper atmosphere. The remarkable advances made in recent years in our knowledge of the intimate constitution of matter bear closely on many problems of upper-atmospheric physics. For this reason a broad summary of modern views on atomic and molecular structure was given, bearing on their states of excitation, ionisation, and dissociation, on the spectra that they emit, and on the effects of impacts between particles of various kinds, electrons, atoms, molecules and ions. Brief mention was made of some atmospheric phenomena in which such considerations are of importance—the spectra of the aurora, and of absorption bands produced by oxygen, ozone, and water; the dissociation of oxygen in the upper atmosphere; and the ionisation of the upper air.

Gypsy Art in Russia

AFTER a period of eclipse following the revolution, the characteristic music of the Russian Gypsies has been revived on lines, it is claimed, more in accordance with its distinctive racial peculiarities than were the Russianised music and singing of the town Gypsies popular under the Tsarist regime. According to an account by M. A. Barannikov (*J. Gypsy Lore Soc.*, ser. 3, vol. 13, pts. 3–4) of Russian gypsy singers of to-day, the Ethnographical Department of the Russian Museum, Leningrad, has formed a gypsy choir selected from both town and nomad Gypsies, of which the repertoire includes all types of gypsy music from the traditional songs of the nomads—in the original form in which they had never been sung by the choirs of town Gypsies—to the Tsigane settings of modern music. Performances have been given in the State Theatre of the Ethnographical Department, of which the object is the preservation, study and presentation of the folk dances, songs and music of the various races under Soviet rule, such as, for example, the peoples of the Caucasus and the Ukraine and even, on occasion, of Turkestan. A similar gypsy studio is now attached to the State Theatre of Moscow.

Progress of Birth Control

THE second annual report, for 1931–32, of the National Birth Control Association has been issued by the Committee. The work of the Association has proceeded vigorously and has been stimulated by the general economic distress in Great Britain. Speakers on the subject of birth control have been supplied for meetings of various organisations. The Birth Control Investigation Committee is incorporated with the Association and investigations on spermaticides, contraceptive appliances, and statistics of birth control have been pursued. Local authorities to the number of 47 have decided to provide birth control advice within the terms of the Ministry of Health Circular No. 1208 of 1931. Terms of membership of the Association may be obtained from the Secretary, 26 Eccleston Street, London, S.W.1.

Greenkeeping Research

THE Golf Green Research Station at St. Ives, Bingley, continues its investigations into problems connected with the management of lawns. Vol. 2, No. 7 of its journal has recently appeared, and contains articles on "The Management of Golfing Turf on Heavy Soil" by G. Samuels, "Mole Draining of Golf Courses on Heavy Land" by R. B. Dawson, "Composts and Fertilisers in Relation to Greenkeeping" by T. W. Evans, "A Greenkeeper's Guide to the Grasses" by I. G. Lewis, and "Common Weeds of Turf" by R. B. Dawson. The Station has already made outstanding contributions to our knowledge of the ecology of the grasses which are used for lawns. Mr. R. B. Dawson and Dr. T. W. Evans have revolutionised our methods of manuring lawns, both of golf greens and garden and are substituting scientific knowledge for the 'rule of thumb' methods or the absence of methods, of the past. The journal may be obtained from the St. Ives Research Station, Bingley, Yorks., price 2*s*. 6*d*. per number.

Announcements

SIR ROBERT HADFIELD has been elected an honorary member of the Academy of Sciences of the U.S.S.R. in recognition of his work for metallurgy. The Soviet Ambassador in London, Mr. I. Maisky, is giving a luncheon in honour of the occasion on February 28.

MR. KENNETH HEADLAM-MORLEY has been appointed secretary of the Iron and Steel Institute in succession to Mr. G. C. Lloyd, who will retire shortly. Mr. Headlam-Morley was educated at Eton and Oxford, where he was a scholar at New College. He joined the staff of Messrs. Dorman Long and Co. Ltd. in 1925; after a technical training in their iron and steel works at Middlesbrough he has been occupied in their Secretarial, Managing Director's and By-Products Departments, and is well acquainted with the iron and steel industry of western Europe.

AT the annual general meeting of the Quekett Microscopical Club, held at 11, Chandos Street, Cavendish Square, W.1, on February 14, the following officers were elected: *President:* Mr. J. Milton Offord; *Vice-Presidents:* Mr. J. Wilson, Mr. C. D. Soar, Mr. J. Ramsbottom, Mr. E. A. Robins; *Treasurer:* Mr. C. H. Bestow; *Secretary:* Mr. W. S. Warton; *Reporter:* Mr. A. Morley-Jones; *Librarian:* Mr. C. H. Caffyn; *Curator:* Mr. C. J. Sidwell; *Editor:* Mr. W. S. Warton; *New Members of Committee:* Messrs. D. Bryce, W. J. Ireland, E. K. Maxwell, and E. C. Reeve.

A COURSE of six lectures on the design of photographic objectives will be given by Dr. W. D. Wright on Tuesdays and Thursdays commencing on February 28, at the Imperial College of Science and Technology, South Kensington, S.W.7. Further particulars can be obtained from the Registrar of the College.

MR. V. J. P. DE BLOCQ VAN KUFFELER, director of the Zuider Zee Works, will deliver an illustrated lecture, in aid of King Edward's Hospital Fund for London, on March 3, describing the way in which the reclamation of the Zuider Zee has been carried out under his supervision. The lecture will be at 5.30, at Drapers' Hall, Throgmorton Street, E.C.2. Admission will be by ticket obtainable either from the Secretary, King Edward's Hospital Fund for London, 7, Walbrook, E.C.4; or from Messrs. Alfred Hays, Ltd., 74, Cornhill, E.C.2; 26, Old Bond Street, W.1; and 62, Strand, W.C.2 but not at the doors.

WE have received from the Association of British Chemical Manufacturers and from the British Chemical Plant Manufacturers' Association, both of 166 Piccadilly, London, W.1, two publications entitled "British Chemicals 1933" and "Official Directory of Members 1933", respectively. These give the names and addresses of firms from whom various chemicals and types of plant are obtainable. The book on British chemicals is printed in several European languages. Copies may be obtained on application to the Association at the above address.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant at the Building Research Station, Garston—The Secretary, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S.W.1 (Feb. 28). A head of the School of Photography at the Polytechnic, Regent Street, London, W.1—The Director of Education (March 3). A teacher of engineering subjects and a teacher of mathematics at the Acton Technical College—H. M. Walton, Education Offices (H.), 10, Great George Street, London, S.W.1 (March 6). Two agricultural inspectors for the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (March 6). A research assistant in mental deficiency at the Royal Eastern Counties' Institution, Colchester—The Medical Superintendent, Royal Institution, Colchester (March 11). An assistant lecturer in geography at the University of Manchester—The Registrar (March 15). A Chaning Wills professor of geology at the University of Bristol—The Registrar (March 16). Three probationary assistant engineers in the Post Office Engineering Department—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (March 16). A lecturer in geology at the University of Durham (Durham Division)—The Head of the Department of Science (March 20). A lecturer in medicine at the University of Aberdeen—The Secretary (March 21). A scientific assistant at the Imperial Bureau of Plant Genetics, School of Agriculture, Cambridge—The Director (March 30). Assistant examiners in the Patent Office—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (June 1).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Rubber Research

Many technologists other than those directly interested in rubber manufacture will have read with feelings of profound misgiving the leading article in Nature of February 11. The closing down of the Rubber Research Laboratory at Croydon and the dispersal of its fine library—one of the most complete special technical collections in Europe—would be nothing short of a catastrophe. For this is no moribund institution, but an active and extremely useful organisation discharging efficiently those duties and fulfilling those aims for which the industrial research associations were called into being.

Referring to the penultimate paragraph of the article, in which allusion is made to the benefits and obligations conferred upon industries by protection, it is only fair to state that the rubber manufacturing industry as a whole realises the benefits of co-operative research and accepts its obligations to maintain itself in a state of efficiency. It is therefore prepared to support the levy scheme as embodied in the Rubber Industry Bill, which it regards as the only workable scheme for securing the financial support necessary for the continuance of the Rubber Research Association. The fact that the Research Association numbers amongst its members no less than 86 rubber firms, including some of the largest in the country, affords ample evidence of the attitude of the majority of the industry in regard to the levy scheme and the Rubber Industry Bill. Yet, despite this preponderance of favourable opinion, the fact that the measure has perforce to be introduced into the House of Commons as a private member's Bill, apparently places it at the mercy of a minority opposition. Surely, in these circumstances, the efforts of the majority deserve the support not only of the Government, but also of all who have at heart the industrial progress of the future.

Regarding the volume and the character of the work which the Research Association has accomplished during the past thirteen years, I can speak with some knowledge. As chief chemist to a firm which has supported the Association throughout and as one well acquainted with its various activities, I can testify, as can many others in similar positions, to the very great practical value and usefulness of the many investigations which have been undertaken, and the results which have been obtained. Concerning the library side, it would be almost impossible to over-rate the value of the services rendered by the Association in the systematic collection, co-ordination and distribution of an enormous amount of scientific and technical information.

A study of the numerous research reports, in which the results of investigations have been published, affords ample evidence of the necessity for a separate organisation for the investigation of the common and fundamental problems of an industry. However well a firm makes provision for the scientific control of its own factory, it can seldom afford the time, staff or equipment required for the adequate study of these problems. From the point of view of economy also it is advisable that unnecessary repetition and overlapping should be avoided so far as possible and this can be ensured only by co-operation.

Attempts have been made in certain quarters to decry the value of the work of the Association but, so far as I am aware, no such attempts have been made by those who have studied, even superficially, the reports of the work done and results attained. Non-members, not having had this opportunity, can scarcely be considered competent to criticise on these grounds. To the minority who are opposing the Rubber Industry Bill, one would like to put the question: Have you any constructive suggestions as to what shall take the place of the organisation to which you object? It may be taken for granted that the objection is to co-operative research in principle.

What will be the effect if this opposition is successful in wrecking or unduly delaying the Bill? This Rubber Research Association, with its valuable plant and specially trained staff, its undeniable record of accomplishment, its library and its great potentialities for future service, will cease to exist. To the rubber industry this will be an irreparable loss, but it will have a far greater significance than that. It will be another blow, and possibly a knock-out blow, to the national movement for co-operative industrial research in connexion with which the Government itself has expended more than a million pounds.

Should the Bill pass to the statute book, however, the occasion may well mark the beginning of a new era for industrial research in which every industry will be able, without external assistance, to maintain and control a research organisation for investigating its own particular problems and for making contact, when necessary, with the similar organisations in other industries.

S. S. Pickles
(Chief Chemist).
George Spencer, Moulton and Co., Ltd.,
Bradford-on-Avon,
Wiltshire.
Feb. 14.

Hexuronic (Ascorbic) Acid as the Antiscorbutic Factor, and its Chemical Determination

Although it is known that specimens of hexuronic acid (since renamed ascorbic acid) possess antiscorbutic properties, it has remained to show whether this activity was an inherent property of the pure substance itself or ascribable to some associated impurity. Experiments to test the point have been carried out in this laboratory, as a result of which a very extensive and constant correlation has been established between vitamin C activity and hexuronic acid. Little doubt can therefore remain as to the identity of the two substances.

Our evidence may be summarised as follows:—(1) In preliminary work it was shown that the antiscorbutic activities of several natural sources ran approximately proportional to the amounts of hexuronic acid recoverable from them: thus suprarenal cortex (ox), not hitherto recognised as an antiscorbutic, had three times the potency of orange juice. (2) Specimens of hexuronic acid from different sources (suprarenal; paprika) were then assayed, and were found to have identical antiscorbutic activity. (3) Hexuronic acid after various repurification processes maintained its original activity. (4) The hexuronic acid contents of numerous natural sources were then determined chemically (by the method described below) and were found to account precisely for their known antiscorbutic activities. (5) In the case of several materials it was also possible to estimate the hexuronic acid content by intensity of absorption at 265 mμ (carried out by W. J. Dann), and this result was in further agreement with the biological or chemical tests. (6) The destruction of hexuronic acid by heat and aeration as measured chemically was found to proceed at a rate similar to that of vitamin C activity. (7) In the guinea pig the antiscorbutic activity of the suprarenal (or liver) was lost with the development of scurvy and this coincided with the disappearance of hexuronic acid. (8) With other species, the rat or dog, which are able to synthesise their own vitamin when none is provided in the diet, the antiscorbutic activity and the hexuronic acid both remain unaffected.

A rapid micro-chemical method has been devised for estimating the hexuronic acid content of foods, involving preliminary extraction with trichloracetic acid and titration against the oxidation-reduction indicator, 2, 6-dichlorophenolindophenol in acid solution. Certain naturally occurring reducing reagents, which were found to react when the reducing capacity of foodstuffs was determined according to the Tillmans technique in more neutral solution, did not interfere by this method (special precautions, however, being necessary in the presence of adrenaline). Sensitivity is about 1 part in 30; an amount of vitamin C represented by 0·03 c.c. of orange juice suffices for an accurate assay; and the determination requires only a few minutes to carry out. Results coincide with those obtained biologically. Values below are expressed as the 'minimal protective day dose' for guinea pig (figures in brackets being the determined or reputed values as measured biologically):

Cabbage 0·9 (1); watercress 1·3 (1); lemon juice 1·5, 1·5 (1·5); orange juice, several types 1·2, 1·5, 1·9 (1·5); grape fruit juice 1·4, 1·5 (1·5–2); pineapple juice 3 (2–3); imported tomato, juice of 4·3 (3–5); banana 6 (5–10); potato 6 (6–10); rhubarb 15 (12); carrots 32 (10–35); grapes 30 or above (> 20, 40); imported peach, juice of > 60 (–).

Horse-radish 0·6 (–).

Apples:—Bramley's seedling, cortex 5·5 (3–5), peel 1·2 (1); Newton, cortex 17 (10), peel 3·7 (3); Blenheim orange, cortex 29, peel 2·7; Edward VII, cortex 53 (> 20), peel 7·5 (2 ?); Cox's orange, cortex 56 (> 20), peel 10 (–).

Ox suprarenal cortex 0·5 (0·5); ox liver 1·3 (< 3); cows' milk 47 (20–60); "Ostermalt" 3·3 (–).

The exact antiscorbutic activity of hexuronic acid has been determined by several alternative methods (curative, tooth structure and preventive): 1·0 c.c. orange juice = 0·5 ± 0·15 mgm. hexuronic acid (or best values = 0·6 mgm.). We recommend its adoption as an international standard.

T. W. Birch.
Leslie J. Harris.
S. N. Ray.

Nutritional Laboratory,
Cambridge.
Feb. 10.

The conclusion having been reached that vitamin C is identical with hexuronic acid, it becomes of obvious importance in the first place to see how this can be reconciled with Zilva's contention[1] that there is a lack of parallelism between antiscorbutic activity and reducing capacity—one of the most characteristic properties of hexuronic acid. Fig. 1 summarises all the data given by Zilva, *mean* values for antiscorbutic potencies being plotted at each level of reducing capacity. Bearing in mind the unavoidable variation in biological response between individual experimental animals, it becomes evident that Zilva's data, once they are analysed in this way, appear in fact to afford good evidence of a close quantitative relation between reducing capacity and antiscorbutic activity in lemon juice fractions, and therefore are not at variance with the hypothesis that hexuronic acid and vitamin C are identical.

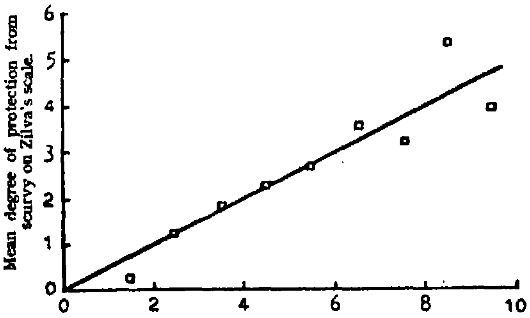

Fig. 1. Relation between reducing capacity and antiscorbutic activity.

Biochemical Laboratory,
Cambridge.
Feb. 10.

W. J. Dann.

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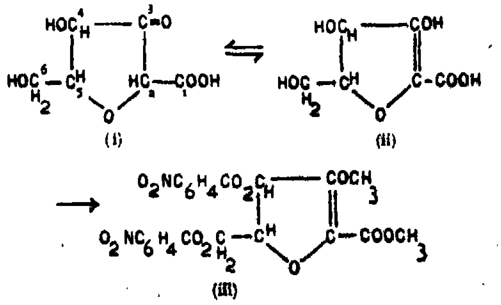
[1] Zilva, *Biochem. J.*, **26**, 1624; 1932.

Constitution of Vitamin C

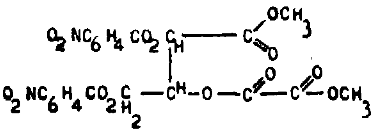
In our first communication[1] we proposed the formulation of vitamin C as a furane- or cyclopentane-derivative. In consideration of further investigations which we have made, we now consider the furane type of structure (i and ii) well established. This conclusion rests upon the following observations; neither the dimethylvitamin nor the di(nitrobenzoyl)-dimethylvitamin (iii) contains a carbonyl group. The



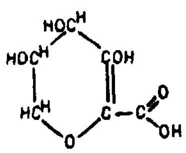
double bond in (iii), which does not react with bromine or with permanganate, is attacked by ozone to give a neutral product, melting point 162°, which does not react with ketone reagents. Its composition is

$C_6H_4O_3(OCH_3)_2(OCOC_6H_4NO_2)_2$. (Mol. wt. in camphor and in benzene.)

Since no reduction in the size of the molecule has occurred, the double bond must exist in a ring. Further, since neither carbonyl nor free carboxyl groups are produced, both the carbon atoms associated with the double bond must be attached to ether-linked oxygen atoms. The ozonisation product is thus formulated as (iv), as the methyl ester of a trihydroxybutyric acid, in which two of the hydroxyl groups are esterified with *p*-nitrobenzoic acid and the third with oxalic acid monomethylester.



(iv)



(v)

In agreement with this, five equivalents of alkali are used in its hydrolysis. The oxalic acid so produced was collected as calcium oxalate and after re-solution titrated with permanganate. The trihydroxybutyric acid is optically active, but its examination is not yet completed. The powerful reducing properties of the vitamin are related to the H–atom, attached to the C_2–atom, which may be readily oxidised to hydroxyl. Its replacement by CH_3, in the enol-form (ii), gives rise in the case of the dimethylvitamin, to a substance stable to oxidising agents. Since the oxidation product is a furanose derivative, its great reactivity is understandable. Besides the structure (i) (and ii), the structure (v), with its corresponding enol-form, may also be possible. In consideration, however, of the observations of Cox, Hirst and Reynolds[2] (production of *d*-threonic acid by permanganate oxidation; formation of furfurol) the formula (v) is excluded (it would yield erythronic acid, since the vitamin gives a monoacetone derivative). Since we have examined the constitution by the mildest chemical methods, secondary changes in this most reactive molecule are excluded. A detailed communication will appear elsewhere[3].

FRITZ MICHEEL.
KURT KRAFT.

Allgemeines Chemisches Universitätslaboratorium,
Göttingen.
Jan. 29.

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[1] 1st communication, *Naturwiss.*, 21, 63; 1933.

[2] NATURE, 130, 888, Dec. 10, 1932.

[3] The substance of this letter was communicated to the Göttingen Chemical Society on January 28.

A Carotene Derivative giving with Antimony Trichloride an Absorption Band at 610–630 mμ.

CAROTENE and vitamin A share with a variety of polyene substances the property of giving a blue solution with antimony trichloride in chloroform. Spectroscopical research shows that carotene gives a specific absorption band with a maximum at 583–590 mμ, whereas vitamin A gives a maximum absorption band at 606–620 mμ with the antimony trichloride reagent.

It is very probable that carotene is converted into vitamin A in the body. Until now, it has not been possible to obtain this reaction *in vitro* by purely chemical treatment.

Recently we have obtained a carotene derivative with an absorption band at 610–630 mμ with the Carr and Price reagent. 150 mgm. of carotene (from carrots) is boiled under a reflux condenser for 15 minutes with a mixture of 100 c.c. of acetone and 1 c.c. of hydriodic acid (sp.gr. 1·7). After cooling to room temperature, 150 c.c. of petroleum ether is added and the acetone washed away with water. The petroleum ether solution is vigorously shaken up for some time with a strong sodium thiosulphate solution. With antimony trichloride in chloroform (with addition of one drop of acetic acid anhydride) a blue colour develops with absorption down to 640 mμ.

The petroleum ether solution, to which is added 20 c.c. of 1 per cent sulphuric acid, is shaken up with small quantities of a dilute (1 per cent) sodium nitrite solution, testing from time to time with the antimony trichloride reagent. A strong absorption band at 610–630 mμ appears. A product with maximum absorption is approximately reached when the colour of the petroleum ether solution has nearly disappeared.

Too much sodium nitrite causes a redder Carr and Price reaction, whereas the absorption at 610–630 mμ decreases.

The substance, although a derivative of carotene and giving the same absorption band as vitamin A, was found to be devoid of growth-promoting activity; small quantities of indol and the inhibitor of cod liver oil caused inhibition of the absorption band.

M. VAN EEKELEN.
A. EMMERIE.

Laboratory of Hygiene,
University, Utrecht.
Jan. 30.

Induction by Coagulated Organisers in the Chick Embryo

IN a series of short communications, Bautzmann, Holtfreter, Spemann and Mangold[1] have recently reported the results of experiments in which they attempted to obtain typical organiser reactions (that is, the induction of a neural plate in the presumptive epidermis in *Triton*) by organisers which had been killed. Marx[2] had previously demonstrated that inductions could be performed by organisers which had been narcotised by trichlorbutyl alcohol to such an extent that they degenerated and were absorbed, while Spemann[3] had obtained inductions by organisers which had been crushed, but not by those which had been frozen or dried.

Holtfreter has been by far the most successful of the newer workers; he reports large and typical inductions by organisers dried at 60°C., or heated to 100°C., or frozen, acting upon either isolated pieces of presumptive epidermis or on the same tissue in its normal place in the embryo. Bautzmann describes two structures, induced by organisers which had been heated to about 60°C., which he is inclined to interpret, now that the possibility has been proved by Holtfreter, as atypical induced neural plates. Spemann has obtained one induction by an organiser killed in 96 per cent alcohol, and Mangold reports some doubtful cases which raise the possibility that the inducing agent can diffuse into agar blocks.

Since October 1931 I have been attempting to obtain inductions by dead organisers in the chick embryo, the organisers being killed either by heat or by acetone. But it was usually found that the dead implanted substance became enveloped by mesenchyme or endoderm cells from the host, and was thus insulated, as it were, from the host ectoderm, so that no inductional effect was obtained or could be expected. The insulation is least efficient in the comparatively mesoderm-free region near the head, but in this situation there is great danger of an induced neural plate becoming incorporated into the host's neural plate and therefore indistinguishable. Two fairly clear inductions have, however, been obtained in this region. In both cases the graft consisted of the anterior part of a chick primitive streak, and was coagulated by being placed, as dry as possible, in a thin-walled glass tube which was then dipped in rapidly boiling water for about 30 seconds.

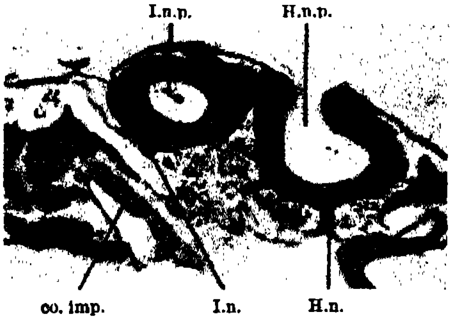

FIG. 1. Section through posterior part of induction. I.n.p., induced neural plate; H.n.p., host neural plate; I.n., induced notochord; H.n., host notochord; co. imp., coagulated implant.

This treatment left the tissue in a hard, almost horny condition: sections show that it has been completely coagulated, and not merely rendered necrotic. In one case the induced neural plate is united throughout its length with the host plate; the combined structure is very asymmetrical and in its folding shows clear indications that it consists of two parallel plates which have united laterally. In the second, and more diagrammatic case, the induced plate is again united with the host plate in the anterior region, but farther posteriorly, at the level of the hind-brain, it is quite separate and is accompanied by an induced notochord (Fig. 1). The presence of the induced notochord shows that we are not dealing, as Spemann concluded for the amphibian experiments, merely with the "Umschlag von präsumptiver Epidermis in Medullarsubstanz", but on the contrary, that the embryonic axes induced in this way may include several, perhaps all, of the axial organs: in fact, that the induced axis has its own "individuation field"[4]. From Holtfreter's account one would have thought that the same was true in the Amphibia.

Although it is perhaps not difficult to imagine the mere presence of a new individuation field being induced by a dead organiser, it is much more difficult to believe that dead material could determine the regional character of the induced field: and in the specimen described it probably has not done so. This is suggested by the fact that the induced notochord extends exactly as far towards the anterior as the host notochord, indicating that the induced axis owes its regional structure to the host. I have recently[4] argued that in normal inductions by living organisers the regional structure of the induced field is determined by the host and the graft working together. It would be very interesting to observe the regional character of neural plates induced by dead organisers near the edge of the area pellucida, where the host's influence is very small and can be overcome by that of a living graft; but as yet all dead grafts in such situations have become enveloped by cells from the endoderm.

C. H. WADDINGTON.

Strangeways Research Laboratory
and Laboratory of Experimental Zoology,
Cambridge.
Jan. 24.

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[1] Bautzmann, H., Holtfreter, Joh., Spemann, H., Mangold, O., *Naturwissenschaften*, 51, 971; 1932.

[2] Marx, A., *Arch. Entw.-mech.*, 128, 333; 1931.

[3] Spemann, H., *Verh. Zool. Ges.*, 1931.

[4] Waddington, C. H., *Arch. Entw.-mech.* (in press).

Life-History of the Fowl Tapeworm, *Davainea proglottina*

IN 1888–92, Grassi and Rovelli[1] fed onchospheres of *Davainea proglottina* to the slugs *Limax cinereus*, *Agriolimax agrestis* and *Limax flavus* and were able in less than twenty days to obtain cysticercoids which when fed to hens developed into *D. proglottina*. In spite of these experiments, the authors did not exclude the possibility of direct infection, since they considered that these intermediate hosts were not present in sufficient numbers to account for the very heavy infection of the poultry in Rovellasca where they worked. Railliet and Lucet[2] attempted to establish direct infection and failed, but they considered that other slugs, in addition to those used by Grassi and Rovelli, could serve as intermediate hosts.

In Great Britain, Meggitt[3] attempted to repeat the experiments and fed onchospheres to the following slugs: *Arion ater*, *Arion hortensis*, *Arion circumscriptus* and *Agriolimax agrestis*. After intervals of 10–35 days the slugs were killed and examined but no cysticercoids were obtained. Meggitt did not consider the experiments conclusive since he experienced considerable difficulty in keeping the slugs alive in the laboratory. Later, Joyeux[4] in France and Bisset[5] in England again failed to establish *Agriolimax agrestis* as an intermediate host. In the United States, however, Chandler[6], by feeding proglottids to two specimens of *Agriolimax agrestis* and one of *Limax flavus* was able to obtain cysticercoids, and later Myrna Jones[7] successfully infected four species of terrestrial snails which are not indigenous to Great Britain.

Only one slug, *Agriolimax agrestis*, was used by all the authors and from their observations it was found to serve as an intermediate host in Italy and the United States but not in France and England. In view of this discrepancy, I proceeded in October 1932 to reinvestigate the life-history with relation to this slug and I have been able to obtain cysticercoids experimentally. Wetzel[8], who has apparently been working for some time on similar lines in Germany, has recently published an extensive paper on the life-history of *D. proglottina*, and I can confirm his observations on the active migration of the onchospheres through the wall of the alimentary canal of the slug and the subsequent development of the cysticercoids in the body cavity or digestive gland.

In view of the failure of previous experiments in Great Britain, a brief account of the technique adopted may be of interest. As I was unable to breed slugs in the laboratory during the autumn, some two hundred slugs were collected; half of them were examined and found to be free from infection. The remainder were used in equal numbers for controls and experiments. They were kept in batches of 10 in Petri dishes (4·5 in. in diameter) lined with damp filter paper. Although the slugs will feed on a variety of vegetable foods, in order to eliminate all possibility of outside infection, they were fed on the foliage cut from wheat grown on moist flannel in the laboratory. The Petri dishes were cleaned, and the filter paper and food were replaced daily.

Active ripe proglottids of *D. proglottina* were obtained from the duodenum immediately after an infected hen was killed. The proglottids were washed rapidly in tap water and then placed on the filter paper in the Petri dishes containing the experimental slugs. The slugs ate the proglottids with avidity and the process could be watched under a binocular dissecting microscope. Some of the slugs were kept at a room temperature of 16° C. and others were placed in the incubator at 24° C. At the former temperature cysticercoids developed in 21–22 days and at the latter in 12–13 days. By killing and examining some of the experimental slugs at varying intervals, the route of infection was established and all stages of the development up to and including the cysticercoids were obtained. At the conclusion of the experiments the control slugs were examined and found to be uninfected.

It does not follow that *Agriolimax agrestis* is the only intermediate host in Great Britain, and further experiments will probably confirm Wetzel's observations that in addition to this form and *Limax flavus*, the young stages of *Arion hortensis*, *Arion circumscriptus*, *Arion intermedius*, and *Cepea nemoralis* may serve as intermediate hosts.

F. J. BROWN.

Molteno Institute,
University of Cambridge.
Jan. 28.

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[1] *Z. Bakter.* I. *Orig.*, 8, 1888 and 6; 1889; *Atti Acc. Catania*, 4; 1892.
[2] *Bull. Soc. Zool. France*; 1892.
[3] *Parasitology*, 8; 1916.
[4] *Bull. biol. France et Belg.*, Suppl. 2; 1920.
[5] *Vet. J.*; 1928.
[6] *Trans. Amer. Micro. Soc.*, 42; 1923.
[7] *J. Parasitol.*, 15; 1929.
[8] *Arch. Tierheilkunde*, 65, Heft 6; 1932.

Phytophthora megasperma causing Pink Rot of the Potato

DURING the course of an investigation into the occurrence and distribution of pink rot of the potato in Northern Ireland, a species of *Phytophthora* other than *P. erythroseptica*, the normal cause of the disease in the field, was isolated from tubers involved in an outbreak of the disease at Culnafay, County Antrim. Numerous isolations made between 1928 and 1932 from diseased tubers occurring in the same field at Culnafay have proved to be *P. erythroseptica*, the species referred to having been obtained on one occasion only. The isolation was made in January, 1930. A series of inoculation experiments has shown that this species causes a tuber rot of the potato indistinguishable from that caused by *P. erythroseptica*. The isolation was found to differ from *P. erythroseptica* mainly by the production of a preponderance of paragynous antheridia and in the large size of its oospores. We are grateful to Mr. Ashby of the Imperial Mycological Institute who has identified it as *P. megasperma* Drechsler.

P. megasperma was first recorded by Drechsler in 1931 as causing a crown rot of hollyhocks in the United States[1] and it would appear that this is the first record of its occurrence outside the United States. Although a number of species of *Phytophthora* will cause pink rot of the potato under conditions obtaining in the laboratory yet, in Northern Ireland, no species other than *P. erythroseptica*, to which must now be added *P. megasperma*, has been found as the cause of the disease in the field.

H. CAIRNS.
A. E. MUSKETT.

The Queen's University,
Belfast.
Jan. 17.

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[1] Drechsler, C., *J. Washington Acad. Sci.*, 21, 513–526; 1931.

Snails and Changes in Sea-Level

IN NATURE of April 7, 1923, p. 464, I directed attention to the great changes in sea-level assumed by some geologists to have occurred during Pleistocene times. Reference was made to the small I. de Cima, close to Porto Santo, in the Madeira group. This islet has a very distinct species of snail, in great abundance, and if the postulated changes in sea-level actually occurred, it is hard to understand why the snail did not reach the main island, or, at another time, perhaps perish beneath the waves.

There has recently been published a still more striking example of a snail fauna on a small island, distinct from that on the adjacent larger island. Dr. A. Wetmore and Mr. F. C. Lincoln in 1931 visited Beata Island, which lies about six miles off Beata Point, the southern end of the island of Haiti. Beata Island is connected with Haiti by a submarine bank, on which there is 12–18 ft. of water. It is about four and a half miles long, and four wide. The U.S. Pilot gives an elevation of 330 ft. for Beata, but Wetmore and Lincoln estimated it to be about 75–100 ft. The island is of limestone, and much eroded.

A collection of land snails from Beata Island was submitted to Dr. P. Bartsch, of the U.S. National Museum, with the following astonishing result: *Chondropoma*: two new species, one representing a new subgenus; *Lucidella*: one new species; *Eutrochatella*: two new species; *Ceratodiscus*: one new species; *Cepolis*: two new species and a new subspecies; *Plagioptycha*: one new species; *Thysanophora*: two new species; *Urocoptis*: one new species; *Brachypodella*: one new species; *Macroceramus*: one new species; *Varicella*: one new species.

Thus the whole snail fauna is apparently peculiar to this small island, separated from the main island of Haiti by a channel said to be as shallow as 18 ft. Here is certainly a problem for the geologists.

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Jan. 20.

Amplification of the Ionisation Produced by Radioactive Sources

VARIOUS devices have been described for employing thermionic valves to measure small current. In most of these, the necessary sensitivity is only obtained by using very sensitive galvanometers in the anode circuit of the amplifying valve, which magnify all irregularities due to faulty filament and anode batteries, as well as 'zero creep' effects due to leakage or accumulation of wall charges. Compensation for anode battery fluctuations can be eliminated by the 'valve bridge' method, but such an arrangement, whilst considerably complicating the circuits, only partly removes the causes of unsteadiness, so that a comparatively low limit of sensitivity is attainable, under steady conditions.

The electrometer valve, which has a grid filament resistance of the order 10^{15} ohms, provides a method of measuring ionisation effects, which seems superior to other valve methods so far described, and compares very favourably with the ordinary standard electrometer methods up to a sensitivity corresponding to 500 divisions per volt.

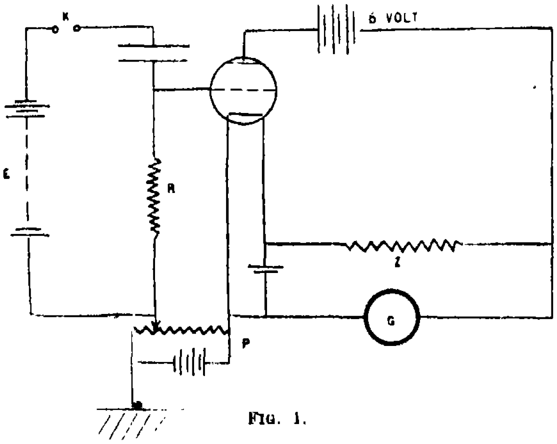

FIG. 1.

The circuit is shown in Fig. 1. A high resistance leak *R* of the order 10^{12} ohms is placed in the grid-filament circuit, and the ionisation current *c* flows through this leak to earth, thereby producing a steady potential *cR* volts across the grid, and a variation of *mcR* microamp. in the steady anode current of the valve. The normal anode current, when the key *K* is open, is balanced by the shunt circuit *GZ*. The mutual conductance *m* of the valve (G.E.C. type) is about 50 microamp. per volt, when the grid bias is -4 volts. Using a galvanometer of 10 divisions per microampere, a single division of the scale corresponds, therefore, to an ionisation current variation of 2×10^{-15} amp. This sensitivity can obviously be increased by using a still higher resistance leak.

Several tests have been made on the ordinary laboratory ionisation experiments and perfectly steady conditions have been obtained over long periods of working. The apparatus has been constructed in a small tin-lined box, fitted with an ebonite panel in which the anode and filament resistances were mounted. To ensure good insulation, the grid lead is brought out through a sulphur plug, and a vessel containing phosphorus pentoxide is placed within the box to keep the glass surface of the valve and leak as dry as possible.

No disturbance from external electromagnetic effects have been encountered, although tests were made when X-ray installations were in operation within the building, and the zero keeps perfectly steady over long periods. Since the anode voltage required is low (6 volts), large capacity cells can be used to minimise fluctuations in normal anode current. The high resistance leaks are best made from xylol-alcohol mixtures contained in narrow sealed tubes, and embedded in paraffin wax to improve external insulation. A potentiometer can be inserted as shown, if a null method of measurement is required.

In a recent test on the rate of decay of thorium, a galvanometer of sensitivity 100 divisions per microampere was employed, the sensitivity of the instrument being thereby increased ten-fold. A tendency for 'zero-creep' was observed. This is rapid when the potentials are first applied to the valve, but gradually decreases and becomes very slow (about 1 mm. per minute) after some time. This creep would appear to be due to leakage or accumulation of wall charges on the surface of the valve.

The application of the method to the X-ray spectrometer is now under investigation. Careful screening of the ionisation chamber and leads are necessary in this case, to avoid electromagnetic disturbances.

I am very much indebted to Prof. W. L. Bragg, who has given me every facility for this work.

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Jan. 2.

Chemical and Biological Effects of Ultra-Sonic Radiation

ULTRA-SONIC radiation (frequency 723,000/sec.) was produced by means of a quartz plate (35 mm. × 35 mm. × 4 mm.).

The effect of this radiation on Ehrlich's carcinoma has been studied by B. Gözsi and found to have no specific effect on this tumour. The chemical action of this radiation has been studied by A. Szalay. The ultra-sonic radiation decomposes cane sugar into mono-saccharides but was found to have no effect on salicyl-phenylester, diphenylether, succinimid, methylal and the benzophenondiphenylacetal of Bruckner. It is not impossible that waves of a higher energy content might attack also such compounds and ultra-sonic radiation might furnish in the end a method for the measurement of the strength of chemical links.

Highly polymerised compounds such as starch, gum arabic and gelatine are easily depolymerised by the radiation employed, as judged by the rapidly falling viscosity. In the case of starch this result was supported by the iodine reaction which changed from blue to the red characteristic for dextrins. Taking into account the very limited effect of the radiation employed on simpler compounds, it seems probable that the observed depolymerisation was not due to the breaking up of chemical links in the stricter sense. It is hoped that ultra-sonic radiation might contribute to the knowledge of the highly polymerised state and to the meaning of molecular weight of highly polymerised substances.

For lack of funds our investigation has been broken off.

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Jan. 23.

Research Items

Hindu Metal Images. Dr. F. H. Gravely and Mr. T. N. Ramachandran of the Madras Government Museum have compiled an illustrated catalogue of the South Indian Hindu metal images in the Museum collections (Bull., N.S., General Section, vol. 1, pt. 2). The Museum has acquired a particularly fine collection of these images, especially during the last thirty years, mostly from treasure trove. All are religious in purpose and are intended to remind worshippers of the divine. Each must conform to a pattern, laid down by tradition and prescribed in the craftman's handbook, which is regarded as a canon of divine origin. Hindu sculptors form a special caste. In these metal figures the emblems of the deities, especially the bow, arrow, mace, spear, and flowers that are prescribed to be held in the hands are often inserted separately, the images being cast with the hands in the holding position. Most images have more than one pair of arms. Of the three principal deities, Brahma has four faces and two pairs of hands, of which the upper right holds a rosary and the left a vessel with a spout. Vishnu carries a discus in the right, and a conch in the left of, usually, the upper pair of hands. Siva the destroyer is generally worshipped as a phallus in the central shrine of his temples; but images of him are also worshipped and are taken round in procession at festivals. His usual emblems in southern India are the axe and the antelope, but in the north the trident is more often seen. Other emblems of this deity are the drum, the skull-cap and various weapons of war. He has two aspects, the benign and the terrible. Siva is sometimes shown combined with Vishnu and sometimes with his consort Parvati, as right half male and left half female. By some it is believed that Vishnu cannot function without his sakti, the female principle.

Mexican and Ecuadorian Copper and Bronze Axes. A trial of the relative hardness of different parts of axes of copper and bronze from pre-Columbian Mexico and Ecuador has been made by M. A. Clement (*J. Soc. Américanistes*, Paris, N.S., 24, 1). The specimens examined are in the Musée d'Ethnographie du Trocadéro. Sixteen of the axes were of Ecuadorian origin, four were Mexican. The parts tested were the butt, the middle and the cutting-edge, the object of the investigation being to ascertain whether the last-named by its harder quality pointed to its having received special treatment. Brinell's test for hardness was used with a Bollée machine giving a pressure of 750 kgm. The Ecuadorian axes were all of pure copper with the exception of two which showed very slight traces of tin, and of sulphur respectively. They weighed from 190 gm. to 1,220 gm. The resulting table of coefficients of resistance shows a range of variation: for the butt, 67–112; for the middle, 59–103; for the cutting-edge, 72–121. In seven implements the cutting-edge is harder than the butt; and four are harder in the butt than at the edge. Two are equal in these two parts, but the middle differs; while one is uniform. The Mexican axes weigh from 450 gm. to 1,030 gm., three of them containing 1·8–3·8 per cent of tin. The coefficient of resistance is, for the butt a range of 48–56, for the middle 49–53, for the edge 50–56, the edge being harder than the rest of the implement. It is evident, therefore, that in both the Ecuadorian and the Mexican axes some process had been employed to render harder the part of the implement to be subjected to shock, and the investigation has produced no evidence against the hypothesis which has been put forward that these pre-Columbian coppers and bronzes were hardened by cold hammering.

Sponges from the North-Western Pacific. Dr. Yaichiro Okada, in his report on the hexactinellid sponges collected by the United States fisheries steamer *Albatross* in the north-western Pacific during the summer of 1906 (*Proc. United States Nat. Mus.*, 81, No. 2935, art. 12, 1932), gives a detailed account of this large and valuable collection of sponges, all from deep water, ranging from 59 to 1,800 fathoms. Altogether there are 42 species and sub-species belonging to 17 genera and 3 sub-genera, 29 species and sub-species being new. This very rich hexactinellid fauna shows a wonderful variety and the live animals must be unusually fine. Unfortunately, they are some of the most difficult of all animals to preserve in anything like their condition in life, although the shape and spicules can be well seen and these serve as diagnostic characters. Naturally, the spicules are very important, and these are well illustrated in clear text figures whilst photographs of the sponges new to science occupy the six plates. Those taken at the greatest depths are *Eurete irregularis* from 1,800 fathoms in brown mud, *Aphrocallistes aleutiana* from 1,046 fathoms dredged with grey mud, sand and pebbles, and *Pheronema surugensis* and *Hyalonema* (*Coscinonema*) *ovatum* from 918 fathoms with green mud and fine sand with *Globigerina*. In many cases the external appearance of different specimens of the same sponge are so dissimilar that only very careful examination of the spicules show them to belong to the same species. Thus *Hyalonema* (*Cycliconema*) *apertum solidum* new sub-species, has one form tulip-shaped, the other with a transversely expanded body like the fruit of a lotus; *Hyalonema* (*Cycliconema*) *hozawai* new species, being tulip-shaped in one form and spindle-shaped in another. In the single specimen of *Farrea sollasii*, there were numerous spindle-shaped larvæ in the maternal sponge body which are probably in an early stage of development.

The Genera *Dictyoconoides*, *Lockhartia*, and *Rotalia*. The mislaying of Carter's type specimens led to considerable confusion in the systematic classification of *Conulites* (*Dictyoconoides*, Nuttall). With the rediscovery of these specimens, Col. L. M. Davies (*Trans. Roy. Soc. Edin.*, pt. 2, vol. 57, pp. 397–428) has cleared up all previous difficulties. The seven species referred to *Conulites* (*Dictyoconoides*) are divided into true *Dictyoconoides* with numerous intercalary whorls in their spires and a new genus *Lockhartia* without such whorls. The distinctions between *Dictyoconoides* and *Rotalia* are discussed and emphasised. The systematic part of the paper is followed by an account of the development of the rotalids and dictyoconus group.

Distribution of Irish Plants and Animals. Dr. Lloyd Praeger has reviewed the problem of the distribution of the Irish flora and fauna in "Recent Views Bearing on the Problem of the Irish Flora and Fauna" (*Proc. Roy. Irish Acad.*, vol. 41, sect. B, No. 8, 1932, pp. 125–145). The author deals with various hypotheses since the time of Edward Forbes, who first discussed the problem of plant and animal distribution in the British Isles, and states that having studied this problem in Ireland for forty years, he still finds himself much where he was at the beginning, a supporter of Forbes's main thesis. Certain plants and animals, including the American and probably the Lusitanian element, survived the main glaciation, these oldest elements having migrated northwards in pre-glacial times or eastwards from America when the intervening barriers of sea were at least much less formidable than they are at present.

Identification of Timbers of *Eucalyptus* Species. Valuable investigation work is being undertaken in many parts of the world with the object of establishing simple methods of identifying timbers. Bulletin No. 67, published under the auspices of the Council for Scientific and Industrial Research, Commonwealth of Australia, comprises Technical Paper No. 5 of the Division of Forest Products and is entitled "Methods for the Identification of the Coloured Woods of the Genus *Eucalyptus*" by H. E. Dadswell and Maisie Burnell. In a foreword, Dr. Boas, chief of the Forest Products Division, states that the macroscopic and microscopic features of some Australian timbers have been studied and keys published for small groups of associated woods. No one had attempted the preparation of a comprehensive key covering any one genus. This work has now been commenced and the bulletin treats of one section of the important genus *Eucalyptus*. The development of methods for the correct identification of the timbers belonging to this genus is discussed. A preliminary separation was made on the basis of the colour of the wood, and two classes, (1) the coloured and (2) the pale coloured woods were arbitrarily formed. The present investigation was confined to the coloured woods, of which some thirty-seven species have been studied. Macroscopic and microscopic examinations were made according to the simpler forms of the usual procedure, the object kept in sight being the preparation of a simple identification key for use for commercial timbers of present and potential value. Such a tentative key is given at the end of the bulletin. The value of simple chemical tests for the separation of species difficult to distinguish by other means is also indicated. Photomicrographs of most of the species are included.

Yangtse-Kiang Flood of 1931. *Matériaux pour les Études des Calamités* (No. 28, pp. 338–351; 1932) contains an account of these great floods by L. Brandt, a member of the Flood Relief Commission in China. Though floods occur every year along the course of the river, especially in the neighbourhood of Hankow, those of 1931 were remarkable owing to their extent and duration. These were due to the unusually heavy rainfall at the end of July, when as much as 5–6 in. fell in one day. At Hankow, the river rose on August 19 to 53·6 ft. above its normal level, and by September 10 had only fallen 2·4 ft. It was estimated that the total area flooded was more than 46,000 square miles, that 45 per cent of the farms in this zone were destroyed, that the length of dams requiring repair was 2,800 miles, and that 10 million inhabitants were driven from their homes. The writer compares these figures with those for the Mississippi flood of 1927, which covered less than 20,000 square miles and deprived 600,000 persons of their homes.

Temperature of the Stratosphere. Dr. Bruno Rolf has described (*Medd. Stat. Meteorologisk-Hydrografiska Anstalt*, 5, No. 5, Stockholm, 1932), in French, the results obtained from *ballons-sondes* launched from Abisko during the years 1921–29. In this period 156 balloons were launched, and despite the sparseness of population in this far northern region (the latitude of Abisko is 68°), 66 of the balloons were recovered and returned; a reward of 10 Swedish crowns was payable for each balloon restored. Most of them fell in the south-east quadrant from Abisko, the Arctic Ocean being to the north-west. Inquiries as to how the sixty-six discoverers found the balloons elicited forty replies; nine saw the balloon actually descend. Twenty-four were returned within 15 days of launching, 36 within ten weeks, 48 within six months, and 60 within a year; one was not returned until 4 years 7 months after its ascent. The horizontal distances travelled by the balloons ranged from 2 km. to 576 km., the mean being 86 km. In sixty-five cases the traces of the Dines meteorographs carried by the balloons were perfectly readable. Very complete tables of the measurements are given in the memoir, providing data up to 20 km. in several cases. The most interesting and important outcome of the measures is to indicate an unexpected and considerable annual variation of the temperature of the stratosphere at this high latitude; the temperature is greatest in summer and least in winter, the range increasing with height above the tropopause, up to nearly 30° C. at 18 km. This is a phenomenon that may be of capital importance in connexion with the general circulation of the atmosphere.

High Pressure Research. The December 1932 issue of the *Proceedings of the American Academy of Arts and Sciences* contains two papers by Prof. Bridgman of Harvard University on the compressibilities and electrical resistances of materials under great hydrostatic or pneumatic pressure. The compressibilities up to about 1,200 atmospheres at 30° and 75° C. of eighteen sulphides, oxides, nitrates and halides belonging to the cubic system were measured by compressing the materials into cylinders about half an inch long and about the same diameter, which were then subjected to hydrostatic pressure and their change of length measured. The values over the first thousand atmospheres range from 1 to 9 parts in a million per atmosphere and decrease as the pressure increases. For halides they increase from the fluoride to the chloride, bromide and iodide in order, the increase from chloride to bromide being least. The electrical resistances of wires of fifteen metals most of which belong to the cubic system were measured at temperatures 0°, −78° and −183° C. and under pressures up to 7,000 atmospheres of helium. The decrease of resistance in each case is very nearly linear with pressure and at the maximum pressure amounts to about one per cent for columbium, rhodium, molybdenum, tantalum and tungsten, nearly 1·5 per cent for copper, nickel, iron, palladium and platinum, 2 per cent for gold, 3 per cent for aluminium and 9 per cent for lead, at 0° C., and the values are generally somewhat higher at the lower temperatures.

Oscillating Quartz Crystal as an Accurate Clock. Scheibe and Adelsberger, working at the Reichsanstalt, have developed the oscillating crystal as an accurate clock (*Phys. Z.*, Nov. 1932). The clock differs in some respects from those which have been studied in the United States. The quartz crystal is a thin rod supported at its nodal points in an evacuated tube and kept in a thermostat. It is driven by an oscillating valve at about 60,000 c.p.s. and this frequency is stepped down to 333 c.p.s. and used to drive a synchronous motor. The equipment was operated from mains through rectifiers and buffer batteries. One of the clocks was compared, over six months, with international time signals and the mean variation from the mean daily rate was 0·002 sec. The going of such a clock is too accurate to be checked astronomically over a short period. A second clock was constructed and the instantaneous rates of the clocks were compared from time to time. After an initial period of 'running in' the mean variation of the rates was 0·0003 sec./day. These figures compare very favourably with those of other high-precision clocks.

Calorific Values of Indian Woods. An investigation into the "Calorific Values of some Indian Woods" from the practical utilisation point of view, has been undertaken by Messrs. S. Krishna and S. Ramaswami at the Forest Research Institute. The results are published in *Forest Bulletin* No. 79 (Govt. of India Press, Calcutta, 1932). For practical purposes, the authors say, qualities other than the heat value have got to be considered. *Pinus longifolia*, for example, has been found to possess an average heat value of 5,015 cal. and *Quercus incana* of 4,600 cal.; but in spite of the difference the oak is preferred to the pine for fuel purposes. The choice of wood for fuel, therefore, does not depend upon its heat value alone; there are other factors of importance such as freedom from smoke, ease and completeness of combustion, rapidity of burning, sparking, etc., which must also be considered in making a selection. Calorific values of 150 species of Indian woods have been determined and the values are expressed on zero moisture and ash-free basis. Values of heartwood and sapwood have been determined separately. In general, although there are exceptions, the heartwood has been found to possess higher calorific value and this is particularly true in species containing resinous and volatile matter. The average heat value of Indian woods (broad leaved) has been found to be 5,016 cal., the value for conifers being about 5,120 cal.

Astronomical Topics

Astronomical Notes for March. Mars and Jupiter reach their most favourable positions for the year, being in opposition on March 1 and March 9 respectively. Neptune is near them, having passed opposition on February 27. No other planets are well placed for observation.

The sun crosses the equator and spring begins at 2 A.M. on March 21.

Two lunar occultations are visible in London; stars of the sixth magnitude disappear at 7.56 p.m. on March 4 and at 11.57 p.m. on March 7.

Mira Ceti is due at maximum early in March, but is too low to see except in the evening twilight. The most conveniently observable minima of Algol occur at 10 p.m. on March 12 and at 7 p.m. on March 15. Those using the B.A.A. Handbook are warned that one day should be subtracted from the dates given there from February 18 until the end of April.

Colour Temperatures of Stars. The observation of colour temperatures of stars has been in progress at Greenwich Observatory for some years, and the results so far obtained have now been issued in a special publication. The 'temperatures' finally deduced from the observations are in reality merely a convenient method of expressing the colours of the stars; and, though intimately related, are not actual temperatures of surface regions. The absolute determination of such colour temperatures by direct comparison with a terrestrial source is extremely tedious. Twenty-five suitable stars were accordingly selected in the first place, carefully compared with one another and with a terrestrial source (acetylene lamp) of known colour temperature, and finally used as standards for comparison with other stars. The actual observations of fresh stars were thus reduced to comparatively simple differential measures with one or more standard stars. The necessary photometric scale was obtained originally by the prism-crossed-by-grating method, but owing to the loss of time due to increased exposure involved, this was replaced by photographing a scale on the plate in the laboratory after exposure in the telescope. Results are given for 63 stars (including the 25 standard stars), and these are preceded by an introduction describing the theory involved as well as details of the apparatus used and practical methods.

New Comet, 1933 *a*. Mr. L. Peltier has made his fourth cometary discovery; he found a comet of the eighth magnitude on February 16. The two following observations were made by Dr. W. H. Steavenson at Norwood:

Feb. $17^{d}\,19^{h}\,41^{m}\,54^{s}$ U.T.	R.A. (1933·0) $23^{h}\,31^{m}\,20{\cdot}54^{s}$	N. Decl. $61^{\circ}\,56'\,52{\cdot}7''$
18 20 0 28	23 56 55·98	61 51 37·2

These will enable a rough estimate of the position to be made; there is not yet material for an orbit, but it is estimated that the perihelion is past, and that the distances from sun and earth are increasing, so the rate of motion may slow down.

A telegram from the U.A.I. Bureau, Copenhagen, gives the following elements and ephemeris of comet 1933 *a* (Peltier) computed by Drs. Anderson and Wyse:—

T	1933 February 7.63		
ω	137°	51′	1933.0
Ω	313	0	
i	84	55	
q	0·9980		

Ephemeris for 0^h U.T.

		R.A.			N. Decl.	
February	21	0^h	52^m	40^s	60°	36′
,,	25	2	21	40	54	44
March	1	3	23	16	46	6
,,	5	4	3	36	37	4

The brightness is diminishing.

Ephemerides of some other comets are given in the B.A.A. Handbook.

Halley's Comet in 1909–11

AN exhaustive discussion of the phenomena of Halley's comet and its envelopes, based on the examination of a large number of photographs taken at the Lick Observatory, at its Chile station, and at Mount Wilson, Johannesburg, Helwan, Kodaikanal, Cordoba, Yerkes, Tokyo, and Beirut, is given by Nicholas T. Bobrovnikoff in a memoir on "Halley's Comet in its Apparition of 1909–1911"; which appears in Lick Observatory Publications, Part 2. The outward motion of luminous patches in the tail was studied, and the repulsive force deduced, the assumption being made that the hyperbolic orbits of these objects were in the same plane as the orbit of the comet's nucleus. The resultant repulsive force was calculated in 31 cases; in 3 cases it exceeded 1,000 times gravity; in 4 cases it was between 100 and 1,000 times; in 6 cases it was between 50 and 100 times. The two tails of the comet on May 29, 1910, are traced on page 457 of the memoir. That of Bredichin's type I is nearly straight, the indicated repulsive force ranging from 9 to 16; the tail of type II is highly curved, the repulsive force being only 0·1 to 0·2. The presence of this curved tail explained the surprising fact that a tail could be seen in the morning sky for some time after the nucleus and straight tail had become evening objects. On account of the curvature of the tail, the author is doubtful whether the earth passed through any portion of it; in any event only the outlying portions could have been traversed.

A study is made of the curved envelopes that surrounded the comet's head. A parabolic outline has generally been assumed for these, but the author finds, as Bond had done in his study of Donati's comet of 1858, that the catenary gives a better representation; it is suggested that the shape may be accounted for if the different envelopes exert some electrical action on each other.

A description was given by Barnard of the appearance of the nucleus. What was taken with a low power to be the nucleus was seen with greater power to be a dense nebulosity of a bluish colour, with a stellar nucleus, 2″ or 3″ in diameter. It may be noted that a similar small nucleus was seen with large instruments at the near approach of the comet Pons-Winnecke to the earth in June 1927.

Reasons are given for believing that the activity of emission, responsible for sending out the envelopes and luminous masses in the tail, is not confined to the small nucleus, but extends to some distance from it. Comparison is made between the envelopes in Halley's comet with those of Morehouse's comet of 1908, which were studied by Eddington. In the case of Morehouse the envelopes showed rapid motion, sensible in a few minutes, and the repulsive forces were several thousand times that of gravitation.

There were a few cases of sudden explosive action in the case of Halley's comet, notably on May 13 (Innes) and May 24 (Barnard), but on the whole the disturbances seem to have been much weaker than in Morehouse's comet.

In 1835 Bessel found evidence of rotation of the nucleus; this phenomenon was therefore looked for, but the fact that jets around the nucleus retained their direction for some days, in one case for a week, makes rotation unlikely. Examination was made whether any of the secondary regions of activity round the nucleus gave evidence of separating from the comet (a phenomenon noted in Biela's comet, in the great 1882 comet, and in Taylor's of 1915). The author thinks that Halley's comet may have been on the verge of disruption, but that this was never quite reached.

An estimate is made of the mass of Halley's comet. The author gives 3×10^{10} of the earth as a lower limit. This is about the mean of the widely different values given by Orlow, but in neither case is it considered more than a guess. As regards the total brightness of the comet in 1910, Holetschek's results are quoted that the comet has not appreciably declined either in light or in length of tail during the last five apparitions. A very different estimate was reached by many English observers in 1910, but this was due to twilight and the comet's low altitude; in the tropics the tail was described as like a great searchlight beam, 140° long; the great length was due to its nearness to the earth. The length in linear units was difficult to compute, owing to great foreshortening; according to Holetschek's discussion it was about a quarter of an astronomical unit on April 21, two days after perihelion, and increased to nearly a unit at the end of May.

The memoir also discusses the comet's spectrum; the continuous spectrum of the nucleus closely resembled that of the stars of solar type λ Serpentis and α_1 Centauri. There is, however, a more rapid falling off of light at the violet end in the comet's spectrum. In this respect the comet resembles the brighter asteroids; the author considers that it denotes the presence of iron in each case.

The author deserves thanks for this painstaking memoir, which describes in close detail the phenomena exhibited by the comet during the time of greatest brightness. Many beautiful photographs are reproduced, including some spectra, and there are many diagrams. The author commenced the work while he held the Martin Kellogg fellowship at Lick Observatory (1927–1929) and finished it when he was a research fellow in the University of California.

A. C. D. CROMMELIN.

Carbon Dioxide in the Sea

IN the biochemical study of life processes in the sea, an understanding of the rôle of the carbon dioxide system is very desirable. In virtue of the excess base always present, sea water contains not only free dissolved carbon dioxide but also many times as much in combination as carbonates and bicarbonates. The equilibrium existing in this system under naturally occurring conditions is a complicated one. It may be displaced by photosynthesis, changes in calcium due to vital processes, decay of dead matter, temperature, salinity and pressure. To the geologist also its study is of importance since it controls the formation of calcareous sedimentary rocks.

The commonest line of attack is to determine hydrogen ion concentration and excess base. The direct determination of carbon dioxide has been a tedious business at best and practically impossible on board ship. For this purpose a portable manometric modification of the Van Slyke apparatus has been introduced by Greenberg, Moberg and Allen,[1] who claim for it the virtues of speed, accuracy and serviceability at sea.

In 1930 a committee, set up by the International Council for the Exploration of the Sea, met at Helsingfors, to go into the whole question of carbon dioxide in the sea. The account of its labours is now to hand.[2] The experimental work covering most aspects of the equilibrium of interest to the marine investigator, appears to have been carried out with exemplary care. It is backed by a mathematical treatment, based on the activity concept, relating the first and second dissociation constants of carbonic acid to the determinable quantities.

There is now no need to undertake the direct determination of carbon dioxide in sea water. From excess base and hydrogen ion determinations, the concentrations of total and free carbon dioxide and of carbonate and bicarbonate ions may be read off directly from tables. A knowledge of temperature and salinity is also required but determination of these is a routine matter in almost all oceanographical work. Furthermore, over large areas of the ocean, excess base has been found to be proportional to the salinity. When this is the case, a rapid colorimetric determination of hydrogen ion concentration gives the key to the whole carbon dioxide system. The importance of this is great since the solution of marine biochemical problems necessitates the accumulation of a large amount of data often under difficult working conditions.

Owing to the thoroughness of the investigation, the conclusions and tables are intermingled with a large mass of mathematical reasoning, without perusal of which they cannot be properly understood. In consequence, the present writer fears that the non-mathematical, non-German-speaking biologist may be tempted to pass over one of the most outstanding contributions to oceanography in recent years. It seems a pity that the tables have not been published with an English summary sufficient for the field worker who is prepared to take their derivation on trust.

Accurate use of the tables requires a knowledge of the temperature coefficient of hydrogen ion concentration in sea water and in the buffers used for colorimetric comparison and also of the dissociation constants of the indicators used for sea water work. This subject was studied by Buch some years ago.

Re-solution of calcium in the sea and the formation of limy deposits at great depths is affected by the displacement of hydrogen ion concentration with pressure and the increased solubility of carbon dioxide. This topic, discussed in the report, has been further extended by Buch and Gripenberg in another publication of the International Council.[3] The change in hydrogen ion concentration with depth is considerable, particularly with an acid water. The *p*H of a water brought from 10,000 metres to the surface would increase by 0·2–0·3 unit. With increasing depth there is a notable rise in bicarbonate ion, accompanied by a decrease in free carbon dioxide and sometimes of carbonate ion. L. H. N. C.

[1] *Ind. Eng. Chem., Anal. Edn.*, **4**, 309 ; 1932.

[2] "Über das Kohlensäuresystem im Meerwasser, Bericht über die Untersuchung einer Arbeitskommission". *Cons. Int., Rapports et Procès-verbaux*, **79**, 70 ; 1932.

[3] "Über den Einfluss des Wasserdruckes auf *p*H und das Kohlensäuregleichgewicht in grösseren Meerestiefen". *J. Conseil*, **7**, 233 ; 1932.

Chilean Insect Parasites for New Zealand

RECENTLY Dr. D. Miller of the Cawthron Institute, Nelson, visited South America for the purpose of studying, among other problems, the influence of the Chilean saw-fly, *Antholcus varinervis*, upon the various species of plants belonging to the genus *Acæna*, the foliage and inflorescences of which are attacked by the larvæ of this insect. Certain species of *Acæna* in New Zealand are important weeds which occupy extensive areas of valuable pasture land, while their burrs reduce the market value of sheep's wool to the extent of some £250,000 annually.

During the researches in Chile, it was noticed that the *Antholcus* larvæ did much more damage to the foliage of the thin-leaved Chilean *Acæna* than to the thick-leaved forms, a feature of considerable value, since the important New Zealand species of the genus are of the former type. One of the difficulties in the utilisation of phytophagous insects for the control of weeds is that there is a danger of the insects extending their food range to plants of economic value; to safeguard this as much as possible involves very careful study. In the case of *Antholcus varinervis*, however, the insect itself overcomes this difficulty in that its larvæ are active throughout the winter months when there are, with the exception of strawberry, no useful rosaceans with available foliage; and in the case of strawberry it has been found that the larvæ will not touch the foliage in the presence of *Acæna*. Dr. Miller successfully transported to New Zealand a large consignment of *Antholcus* pre-pupæ packed in soil and carried in cool store (40° F.). In New Zealand the insects have developed and attacked *Acæna* in a very satisfactory manner, and there is every prospect of an outstanding success in the control of the weed.

When dealing with *Antholcus* it was found that certain species of Chilean *Thynnidæ* attacked cockchafer larvæ. Just as in many parts of the northern hemisphere, the control of native cockchafers is one of the most outstanding agricultural problems in New Zealand, where the larvæ destroy great areas of pasture as well as various crops the roots of which are attacked, while the beetles, as defoliators, cause extensive destruction to turnip and rape crops. Therefore the importance to New Zealand of the Chilean thynnids was at once recognised and arrangements were made for one of the species to be dispatched to the Dominion; this species, *Elaphroptera dimidiata*, is now being studied at the Cawthron Institute. It is of importance to note that the two parasites, *Antholcus varinervis* and *Elaphroptera dimidiata*, both belong to groups not represented in the New Zealand fauna, and, when established in their new environment, should not be seriously influenced by indigenous entomophagous insects. Further, the New Zealand cockchafer larvæ are remarkably free of parasites, a fact that will benefit the influence of *E. dimidiata* upon these hosts.

In the periodical transport of parasites from Chile, one of the difficulties to be overcome was the absence of direct shipping, which necessitated the transport of material through the tropics by way of Panama. However, the British Consular Service rendered invaluable assistance and willingly undertook the shipping of consignments from Chile and their transhipment to New Zealand boats at the Panama Canal; this system has worked admirably. The researches in Chile were carried out in collaboration with Bro. Claude Joseph (who had been undertaking researches on behalf of New Zealand for some time), at Temuco and in the surrounding Araucanian territory. Bro. Joseph has taken a supply of *Elaphroptera dimidiata* to France in the hope that it may prove effective in the control of the European cockchafer (*Melolontha melolontha*).

Correlation of Meteorological Data

IN a recent publication, Sir Gilbert Walker discusses certain meteorological and solar statistical relationships worked out by E. W. Bliss (*Mem. Roy. Met. Soc.*, 4, No. 36). Many years have elapsed since the work of Tesseirenc de Bort and Hildebrandsson showed that there are regions where the changes of certain meteorological elements are correlated with the changes in the same or different meteorological elements in places so far distant that the discovery of the connexion came as a surprise, and seemed to open up prospects of a greatly increased understanding of the workings of the general circulation of the earth's atmosphere. The work has had practical results in seasonal weather forecasting, for example, in the predictions of the character of the Indian monsoon organised by Sir Gilbert Walker, but has thrown very little light on the physics of the general circulation. So far from providing important generalisations such as would simplify the study of world meteorology, it has resulted in an enormous number of statistical relationships from which cause and effect can seldom be disentangled.

Sir Gilbert's present paper is an attempt at arriving at more definite ideas about the relationships of three important groups of action centres which have been called the North Atlantic, the North Pacific and the Southern oscillations. Each oscillation is defined as the algebraic sum of the deviations of meteorological elements at a number of places in or near the area from which it derives its name. For the North Atlantic, the pressure difference between the Azores and Iceland, and consequently the intensity of the 'westerlies' of that ocean, is an important ingredient in the oscillation. Tables of correlation coefficients are given between the values of the oscillations in individual seasons and pressure, temperature and rainfall at places widely distributed throughout the world, and between the oscillations themselves. As sunspots are believed to be related to the energy radiated by the sun, and it is this energy that maintains the general circulation of the earth's atmosphere, coefficients are also given between the figures for sunspot activity and those for the three oscillations.

The tantalising nature of the results obtained in such studies is well illustrated by the existence of a correlation coefficient of + 0·84 between the winter and subsequent summer values of the Southern oscillation. This degree of connexion is remarkable for meteorological conditions separated by an interval of half a year, but the result has not so far been explained on any physical basis.

University and Educational Intelligence

CAMBRIDGE.—The Rockefeller Foundation has given £500 to the Molteno Institute of Parasitology for the purchase of instruments and for assistance in connexion with investigations to be carried out by Prof. D. Keilin.

The Goldsmiths' Company has presented £12,500 to increase the endowment of the Goldsmiths' professorship of metallurgy. The original offer of £10,000 has been increased to the larger sum in view of the fall in rates of interest.

The Gordon Wigan prize for chemistry has been awarded to Mr. T. P. Hoar, Sidney Sussex College, for a thesis entitled "On the Mechanism of the Corrosion of Iron and Steel".

THE twelfth annual vacation course in spectroscopy, interferometry, nephelometry and refractometry will be held on March 30–April 5, at the Zoological Institute of the University of Jena. Further particulars and a syllabus of the course can be obtained from Messrs. Carl Zeiss, Ltd., Mortimer House, 37–41, Mortimer Street, London, W.1.

THE Board of Education is prepared to consider applications for full-time studentships from teachers with at least five years' teaching experience, who desire financial assistance to follow courses of advanced study at universities or other institutions at home or abroad. Particulars of the awards and application forms are obtainable from the Board of Education, Whitehall, S.W.1.

THE sixth annual list of holiday courses in Europe has been prepared and recently published by the League of Nations' Institute of Intellectual Co-operation, acting under the recommendation of the Directors of National University Offices. The list is very comprehensive but only includes those courses which are open to foreigners. Such details as are available are given with each course, together with descriptions of certificates, etc., awarded, facilities for travelling and residence, and names of officials to whom to apply for further information. The pamphlet is published in English, French and German. The English edition can be obtained from Messrs. George Allen and Unwin, Ltd., 40 Museum Street, London, W.C.1 (price 2*s*.).

Calendar of Nature Topics

Spring Wheat

Great Britain expects at least twice the yield per acre of wheat that the great producing areas of the world obtain, and distinctly more than the average yield of France and Germany, because the climate is admirably suited to the production of heavy yields. Only Belgium and Denmark obtain greater returns per acre. High yields in Great Britain are associated with the distributed rainfall and long period of growth obtained by autumn sowing. Spring sowing, on the other hand, is the practice in countries having severe winters and hot summers, while elsewhere the use of quickly maturing varieties is necessary when only a few months of the year are really favourable to the growth of wheat. A short growth period is associated with a low level of yield. In the ordinary way, spring-sown wheat is rare in England and is only grown because some circumstance has interfered with sowing at the normal time. This spring, however, it is to be expected that more wheat will be drilled than usual. The crop now stands in a relatively favourable position to the other cereals since the price is known in advance. Early maturity is the important quality in a spring wheat and special varieties, usually French, are used. The ordinary autumn wheats are not suitable, but one of them, Little Joss, is exceptional in this respect and has quite a good reputation as a spring wheat. In order to give a return approaching that of the ordinary wheat, the spring sown crop requires every help that a mellow and fertile seed-bed can provide, and if these conditions can be secured in February the better the prospect for the crop.

The Mole's Winter Store of Earthworms

In the middle of last century Edward Jesse, in his "Gleanings of Natural History", first published the story that, during the winter, moles (*Talpa europæa*) form underground chambers in which earthworms are stored, so mutilated that they cannot escape; but the belief seems to be widespread amongst mole-catchers. On the other hand British naturalists have generally thrown doubt upon the story, regarding it, like Barrett-Hamilton, as "a result of imagination rather than an invention", supported by "no trustworthy evidence". But good evidence did exist even when Barrett-Hamilton wrote. In 1886 Fr. Dahl recorded that he had found in a mole's fortress as many as 1,280 earthworms stored up in the nest-cavity and in the adjoining runs, where they were firmly embedded in the mud walls in small groups of about ten in number; and in 1891 Prof. Ritzema Bos recorded that in February he had received about 300 earthworms found in a mole's fortress. In both cases the worms were damaged: Dahl regarded the damage as being due to forced cramming into the wall; Bos described in careful detail that the mole had bitten off from three to five of the foremost segments of each worm; that the wounded fore end had been covered by a new skin, but no other regeneration had taken place, perhaps because the winter temperature had been too low for this vital process.

Experimental Evidence of Storing by Mole

If further testimony to a remarkable habit was necessary, it has been provided by the experiments of Magnus Degerbøl with a mole he kept in captivity for about six months during the winter of 1922–23. When the mole was supplied with more worms than it could eat, and the earth in its box was only a few centimetres deep, it scraped aside the earth in one corner, seized a worm, crammed it into the hole to the accompaniment of a crunching noise, and finally covered it up with earth which it patted into firmness with its snout. Ten worms were thus buried, and when Degerbøl retrieved them he discovered that one or more of the anterior segments had been bitten clean off. When deeper earth was placed in the box so that the mole could make runs below the surface, it carried the worms below, burying 49 large individuals in 40 minutes. When the runs were dug out the worms were found half coiled and embedded in the walls, a thin layer of earth separating each two worms; fourteen had their foremost segments bitten off, a single one had its hind segments nearly bitten off, and 34 were unhurt. This was the only occasion on which Degerbøl found the anterior end undamaged, and he attributed it to the embarrassment of the mole at the overwhelming supply of worms, a condition of affairs not likely to arise in natural conditions. The mole touched the surface of a worm with its snout before deciding which was the fore end.

The Purpose of the Mole's Store

As to the purpose of these stores, the existence of which can now be accepted, more information is required. The general idea is that they form a reserve of provender laid by to serve when food becomes scarce in hard weather. But Jesse stated that the basins "appear to be formed in the winter and to have the chief supply of worms deposited in them during the spring months", and Dahl found that the stores were greatest after a prolonged frost—periods at which a true winter store would be at a low ebb. May it be that the storing impulse is not seasonal, and that the size of the store after frost depends either upon the ease with which worms are caught in cold weather, as Dahl suggests, or upon the slowness of regeneration of the tip in cold weather, so that the worms cannot escape so quickly, as suggested by Degerbøl? Some mystery still surrounds the mole's stores, but simple field observations which could be carried out now and during the spring ought to solve the problems.

Spring Increase of Planktonic Diatoms

The latter part of February may show the beginning of the spring maximum of planktonic diatoms in the sea. All-important as food for the small floating animals—especially the larvæ of Crustacea, worms, molluscs and echinoderms which hatch out during and after this large outburst—the diatoms every year multiply in huge numbers during the spring, dwindling again later after depletion by the hordes of creatures feeding on them. In some years this diatom maximum may be early, in other years late, but it always occurs between February and April inclusive.

In 1932 the maximum occurred in the English Channel near Plymouth in March. On March 21, at a point several miles outside the Eddystone Lighthouse, the following diatoms in order of abundance were mainly responsible for the large numbers:—*Coscinodiscus granii*, *Bacillaria paradoxa*, *Skeletonema costatum*, *Chaetoceros sociale*, *Coscinodiscus concinnus*, *Thalassiosira gravida*, *Biddulphia regia*, *Biddulphia sinensis*, *Thalassiothrix nitzschioides*. Most of these species are common members of the spring plankton in those regions, but it is unusual to find *Bacillaria paradoxa* so far from the coast in such huge numbers; and the presence of the two *Biddulphia* species at this time of the year in profusion is abnormal, their usual season being late summer, autumn, and the early winter months.

March Winds

The traditional breeziness of March is expressed in numerous proverbs, and in the French Revolutionary Calendar of 1793 the period February 19–March 20 was the month *Ventôse*—'windy'. At Kew Observatory the average wind velocity in March is greater than in any other month, though only slightly exceeding that in February and April, but the impression of windiness is probably to a large extent subjective, resulting from a combination of causes. The relative humidity is decreasing rapidly, giving the air a brisk drying quality, and the mud of

February turns to dust, which is stirred by the breeze. The warming of the ground makes the lower air unstable, sometimes forming small dust-whirls. The broken clouds appear to drift rapidly, forming a 'windy sky'. Boisterous weather is not expected to last throughout the month, however, and it is proverbial that "if March comes in like a lion, it will go out like a lamb".

Societies and Academies

LONDON

Royal Society, Feb. 16. P. M. S. Blackett and G. Occhialini: Some results of the photography of the tracks of penetrating radiation. About 500 photographs have been taken of these tracks, using an automatic method by which the passage of the particles through two counters causes the expansion to occur. The most striking feature of the results is the extraordinary variety and complexity of the multiple tracks, some of which show more than twenty separate tracks. An analysis of the nature of the particles producing these tracks leads to the conclusion, already put forward tentatively by Anderson (*Science*, Sept. 9, 1932), that some of the tracks are due to particles with a positive charge, but with a mass comparable with that of an electron rather than with that of a proton. These 'positive electrons' seem to be produced during the nuclear collision processes giving rise to the showers. W. E. Garner and H. R. Hailes: Thermal decomposition and detonation of mercury fulminate. Single crystals of mercury fulminate have been heated in vacuum at temperatures between 100° and 150° C. and a detailed examination made of the decomposition which ensues. In vacuum the thermal decomposition passes into detonation at 105°–115° C. The conditions which govern the inception of detonation have been investigated. The thermal decomposition occurring below the ignition temperature occurs in three stages: (1) a quiescent period during which there is a slight browning of the crystal, the decomposition being mainly superficial; (2) a period of acceleration of the rate of reaction; and (3) a region where the equation of the first order applies. These results have been interpreted as due to the commencement of thermal decomposition in the Smekal cracks of the fulminate crystal and the spread of the reaction to crystallites isolated by the destruction of the cementing material. The critical increment of the thermal reaction is approximately 30 k. cal. C. R. Bailey and A. B. D. Cassie: Investigations in the infra-red region of the spectrum. (8) The grating spectrometer previously described has been applied to certain bands in the infra-red spectra of sulphur dioxide, carbon disulphide, and ozone. The upper limit of resolution at which the spectrometer has been used corresponds to a slit width containing some 2 cm.$^{-1}$. As a consequence, a previously unsuspected *Q* branch has been revealed in one of the sulphur dioxide bands, which makes it certain that this molecule is an isosceles triangle with a vertical angle of 120°. The structure of ozone is briefly discussed, but sufficient evidence is not available for a definite conclusion.

PARIS

Academy of Sciences, Jan. 9 (*C.R.*, 196, 73–143). L. Lecornu: The variable rotation of a solid of revolution. C. Matignon and M. Séon: The action of steam on hexane. Description of experiments on the reaction between hexane and variable proportions of steam at 1050° C. in the presence of zirconia as catalyst. The main products were hydrogen and carbon dioxide. Similar results were obtained when benzene was substituted for hexane. Lucien Daniel: The modifications of the reserve function in various plants when submitted to intermittent watering. P. Dubreil: Mixed total intersections in three dimensional space. S. Banach and S. Mazur: The linear dimension of functional spaces. J. Schauder: Linear partial differential equations of the elliptic type. Caius Jacob: A mixed problem in the circular ring. J. Colomb: The Amsler planimeter. Corrections and additions to work on the same subject by Resal. Pol Ravigneaux: A new apparatus for calculation with slide rules. G. P. Arcay: The influence of vibrations on the rate of chronometers. Constantin Woronetz: The influence of temperature on the stability of gyratory movements of fluids. J. Dufay: The brightness of the extragalactic nebulæ and the absorption of light in the Milky Way. S. Soboleff: A problem of the diffraction of waves. R. de Mallemann and P. Gabiano: The magnetic rotatory power of chlorine and of hydrochloric acid gas. The atomic rotation of chlorine gas is about ten per cent higher than that found in the vapours of chlorine compounds: the value for hydrogen chloride is five per cent higher than the sum of the atomic rotations of its constituents. Ny Tsi-Ze and Chien Ling-Chao: The influence of pressure on the photographic sensibility to various monochromatic radiations. The influence of pressure on the photographic sensibility varies greatly with the wave-length and decreases as the wave-length decreases. Mlle. Suzanne Veil: The rhythm of crystallisation caused by the diffusion of alkaline carbonates in gelatine. E. Carrière and Mlle. Carlini: The decomposition of thiosulphuric acid in dilute solution at the boiling point. The products of decomposition were sulphur dioxide, sulphur, sulphuric and pentathionic acids. Mlle. A. Pinguet: Oxyallantoin. Pariselle and Barbier: Contribution to the study of the cadmium tartrates. P. Carré and D. Libermann: α-Phenyl-γ-oxybutyric acid and its lactone. Wiemann: The synthesis of vinylpropenylglycol. Mme. Ramart-Lucas and Mlle. Wohl: The colour and structure of amides. The study of the absorption of substituted amides leads to the conclusion that an amide, in the liquid or dissolved state, is a mixture of two isomers in equilibrium, amide and iminoalcohol. Mme. Bruzau: The spontaneous resolution into active isomers of 4-methoxy-methyldesoxybenzoin, $C_6H_5.CH(CH_3).CO.C_6H_4.OCH_3$. F. Roman and M. Gautier: The presence of a Bathonian pyritic level in the region of Rar-el-Maden, near Nemours (Oran). Idrac: An apparatus capable of measuring and recording vertical submarine and sublacustral currents. J. Duché: Obtaining clones with fixed properties in the Actinomyces. J. Millot: The systematic position of the spiders of the genus *Liphistius* according to their internal anatomy. Raymond-Hamet: The variability of the effects of sparteine on the intestine in situ. Philippe Fabre and Pierre Faidherbe: The constancy of the limiting slope, inverse variations of the chronaxy and of the linear constant in the course of electrotonus of the nerves. Z. M. Bacq and V. Henri: A spectroscopic proof of the formation of substances by the stimulation of the cardiac nerves. G. Sandulesco, Wang Wen Tchung and A. Girard: Contribution to the knowledge of female sexual hormones. The picrates and styphnates of the crystallised hormones equilenine and folliculine were prepared, and found to be of service in purifying and separating these hormones.

SYDNEY

Linnean Society of New South Wales, Oct. 26. GLADYS CAREY and LILIAN FRASER: The embryology and seedling development of *Aegiceras majus*, Gaertn. This mangrove is characterised by vivipary. After fertilisation the embryo sac enlarges, first by resorption of the nucellus and later by penetration into the micropyle. The cells of the integument in the region of the micropyle, being meristematic, keep pace (by their division) with the advancing sac so that the sac does not at any time emerge from the micropyle. At the same time numerous endosperm nuclei are formed which later give rise to an endospermic tissue in the much enlarged sac. The cells of the integument divide rapidly, and so folds are formed around the embryo sac. The fruit is shed from the tree and under favourable conditions the embryo becomes established in the soil. C. DEANE: New species of Corylophidæ (Coleoptera). Descriptions of new Australian species of Corylophidæ (Coleoptera) under two genera, one of which is submitted as new. Two other genera, not previously figured, are illustrated. IDA A. BROWN: Late Middle Devonian diastrophism in south-eastern Australia. During this period, the meridional geosyncline of earlier Palæozoic times was finally closed up and the south-eastern portion of Australia was permanently welded on to the continental massif. This period of diastrophism appears to be equivalent to the Brunswickian or Arcadian revolution of eastern North America and to the disturbance represented by the unconformity between Lower or Middle and Upper Old Red Sandstone of northern Britain. It may be regarded as one of the major orogenic epochs of the Palæozoic era.

VIENNA

Academy of Sciences, Oct. 27. R. WEGSCHEIDER: (1). Further contributions to photochemical kinetics. Formulæ are derived for the course of photochemical reactions from the light-absorption of all the substances present. (2) Photochemical transformation of *o*-nitrobenzaldehyde (ii). The available data concerning this change in the light may be interpreted by assuming a partial inactivation of the molecules affected by light. ADOLF FRANKE, ALFRED KROUPA and SOLON HADZIDIMITRIU: A synthesis of α-alkyladipic acids. A general method of synthesis is applied to the preparation of α-n-hexyl- and α-n-octyl-adipic acids. The acids obtained are identical with those which were prepared earlier from oxydodecane and were inaccurately described as α-n-amyl- and α-n-heptyl-pimelic acids. LUDWIG OTTO KOBLMULLER and RUDOLF VIERTHALER: An arrangement for transferring single-cell cultures to solid nutrient media. Use is made of an adjustable arm carrying a nickel wire pointed to a thickness of 1 micron by treatment with a nitrite solution. FRANZ WERNER and RICHARD EBNER: Results of a zoological expedition to Morocco (1930): (5) Scorpions. The scorpion fauna of Morocco has been revised and a new species, *Buthus barbouri*, and a new sub-species, *Scorpio maurus legionis*, added. FRANZ WERNER: A new snake from the Cyclades Islands. This new species, *Elaphe rechingeri*, is allied to *E. longissima*, which occurs rarely and only in the extreme west of the Greek mainland. HERMANN TERTSCH: Results of cleavage measurements of galena.

Nov. 3. KARL PRZIBRAM: Recrystallisation and blue rock-salt. (1) The rarity of the blue salt is attributed to the fact that its formation requires in addition to the actions of radiation and pressure, also a low re-crystallising power, this being occasioned by the presence of impurities. (2) Observations on natural blue rock-salt. (3) Further representations of this salt show the formation of diffusion regions, the arrangement of the colour in growth zones and along slip surfaces, and the connexion between the blue coloration and the presence of sylvine. FRANZ KAHLER: Geology of the Karawanken Mountains. FRANZ HERITSCH: The northern boundaries of the Carinthian Alps. FRANZ KAHLER: The Rattendorf Alm and the Nassfeld region. FRANZ KAHLER and FRANZ HERITSCH: The stratigraphic arrangement of the Nassfeld strata. KARL METZ: (1) A fauna from the Hochwipfel strata of the Carinthian Alps. Together with forms capable of only general definition, the following were identified: *Schellwieniella crenistria* Phill.; *Retzia* (*Hustedia*) *radialis* Phill.; *Spirifer trigonalis* Mart.; several *Rhombopora* species, comparable with American forms; *Chainodictyum laxum* Foerste; *Chainodictyum laxum* var. *minor* Ulrich, and a new *Septospora* (?). (2) Details of the Nassfeld strata from Schulterkofel westwards. HEIMO HERITSCH: Geology of the crystalline zone of the Gail valley. WALTER PASSER: A static process for the calculation of networks of lines.

Nov. 10. G. GORBACH and A. SCHONBECK: Influence of hydrocyanic acid on bacterial proteases. In certain cases, hydrocyanic acid enhances the degradation of the proteins of culture media by *Bacillus pyocyaneus*. ERICH NIEDERDORFER: Measurements of the heat interchange over snow-covered soils. MARIETTA BLAU and HERTHA WAMBACHER: Experiments on the photographic detection of protons liberated by neutrons (2). These protons may be readily detected by using Imperial process plates previously desensitised by treatment with pinakryptol-yellow. The greatest lengths of path thus observed indicate, for the neutron energies, considerably higher values than have been formerly assumed. FRITZ SOCHTING: Vibration amplitudes in resonance. ARTHUR HAAS: Possibility of a cosmological interpretation of the quantum. FRANZ HERITSCH: The Carinthian Alps (1 and 2). ERICH HABERFELNER: Geological survey between Plöckenpass and Hochwipfel. HANS SEELMEIER: Graptolites from the Gugel (district of Stranigeralm).

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, 633–676, Nov. 15, 1932). A EMERSON WARREN: Xanthophores in *Fundulus*, with special consideration of their 'expanded' and 'contracted' phases. Isolated scales in Ringer's solution released cells which included xanthophores in various states, all of which showed distinct cell outlines, while some had extended processes. Normal freshly fixed material from fish adapted to yellow and to black backgrounds showed cells with nuclei, containing sulphur yellow and orange carotinoids and also reddish granules; in contraction the latter were not always drawn towards the central body of pigment. It is concluded that xanthophores, like melanophores, are of relatively fixed and constant form. WILLIAM ROWAN: Experiments in bird migration. (3) The effects of artificial light, castration and certain extracts on the autumn movements of the American crow (*Corvus brachyrhynchos*). The normal southward autumnal migration was reversed, to some extent, after increasing artificially the length of the day for five weeks during October-November 1931. Castrated birds went southwards. A non-migratory group was produced by treating caponised birds with injections of an extract from male human urine. All birds migrating maintained the north-west-south-east line of flight characteristic of Alberta crows, although liberated at a non-migratory season. Maps showing distribution of recovered birds and records of observations are given. FRANK H. CLARK: Hydrocephalus, a hereditary character in the house mouse. This lethal character is transmitted as a simple recessive unit character, and it may be linked with the gene producing a flexed tail. M. DEMEREC: Rate of instability of miniature-3 gamma gene of *Drosophila virilis* in the males in the homozygous and in the heterozygous females. W. M. DAVIS: Glacial epochs of the Santa Monica Mountains, California. A new coastal road has provided exposures indicating that the region has suffered three periods of sea abrasion at different levels, with which alternated two epochs of withdrawal of the sea and platform emergence. These withdrawals are believed to mark the beginning of two glacial epochs, but there is no evidence of glaciation in the Santa Monica Mountains themselves, which are too low for such records. G. A. MILLER: The commutator subgroup of a group generated by two operators. L. A. MACCOLL: On the distributions of the zeros of certain analytic functions. MAURICE FRÉCHET: On the behaviour of the *n*th iterate of a Fredholm kernel as *n* becomes infinite. NEAL H. MCCOY: On the function in quantum mechanics which corresponds to a given function in classical mechanics.

Forthcoming Events

Monday, Feb. 27

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Sir Douglas Mawson: The Banzare Film (illustrating the recent voyage of the *Discovery*).

Tuesday, Feb. 28

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4.30.—Major G. St. John Orde Browne: "Economic Development in Tropical Africa as affected by Labour Supply".

Wednesday, March 1

BEDFORD COLLEGE, LONDON, at 5.15.—"Contemporary Developments in Science". Sir Henry Dale: "Ultramicroscopic Organisms and the Troubles which they Cause".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. A. E. Richardson: "Library Design".

SOCIETY OF PUBLIC ANALYSTS, at 8.—(at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1).—Annual General Meeting.

Thursday, March 2

ROYAL INSTITUTION, at 5.15.—A. R. Hinks: "Geography in the Public Service".

INSTITUTION OF CIVIL ENGINEERS, at 6.—(Extra Meeting).—V. J. P. de Blocq van Kuffeler: "The Zuider Zee Works".

Friday, March 3

BEDSON CLUB, at 6.30.—(in the Chemistry Theatre, Armstrong College, Newcastle-upon-Tyne).—Prof. R. Whytlaw-Gray: "The Accurate Determination of Atomic Weights by the Method of Limiting Densities".

PHYSICAL AND CHEMICAL SOCIETIES OF THE UNIVERSITY COLLEGE OF SOUTH WALES AND MONMOUTHSHIRE, at 7.—Prof. W. A. Bone: "Britain's Coal Problems".

GEOLOGISTS' ASSOCIATION, at 7.30.—(in the Architectural Theatre, University College, Gower Street, W.C.1).—Annual General Meeting. A. L. Leach (Presidential Address): "The Geology and Scenery of the South Pembrokeshire Coast".

ROYAL INSTITUTION, at 9.—Sir Douglas Mawson: "The New Polar Province".

Official Publications Received

GREAT BRITAIN AND IRELAND

King Edward's Hospital Fund for London. Provision for the Professional and Middle Classes at Voluntary Hospitals in London. Pp. 20. (London: George Barber and Son, Ltd.) 3*d*.

The British Electrical and Allied Industries Research Association (Incorporated). Twelfth Annual Report, October 1, 1931, to September 30, 1932. Pp. 94. (London.)

Proceedings of the Royal Society. Series A, Vol. 139, No. A838, February 1. Pp. 237-474. (London: Harrison and Sons, Ltd.) 12*s*.

Proceedings of the Prehistoric Society of East Anglia for 1932. Vol. 7, Part 1. Pp. v+148+17 plates. (London: H. K. Lewis and Co., Ltd.) 15*s*. net.

The Carnegie Trust for the Universities of Scotland. Thirty-first Annual Report (for the Year 1931–32) submitted by the Executive Committee to the Trustees on February 8, 1933. Pp. iv+86. (Edinburgh.)

Empire Cotton Growing Corporation. Reports received from Experiment Stations, 1931–1932. Pp. ix+172. (London.) 2*s*. 6*d*.

The Journal of the Royal Horticultural Society. Edited by F. J. Chittenden. Vol. 58, Part 1, February. Pp. 234+ix+xvi+60 plates. 7*s*. 6*d*. Report for the Year 1932, with Statement of Accounts; Arrangements for the Year 1933; List of New Fellows, etc. Pp. 174+xlviii. 1*s*. (London: Royal Horticultural Society.)

OTHER COUNTRIES

Scientific Papers of the Institute of Physical and Chemical Research. No. 402: Über die Synthese einiger Methoxymethyl-alkyl-ketone und ihre Beziehung zum Aroma der Gärungsprodukte. By Suttekiti Maruyama. Pp. 53–62. (Tokyo: Iwanami Shoten.) 15 sen.

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau central de Magnétisme terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 10. Pp. iv+138. (Paris: Les Presses universitaires de France.)

Report on the Operations of the Department of Agriculture, Madras Presidency, for the Year 1931–32. Pp. 45. (Madras: Government Press.) 1.2 rupees.

Ward Memorial Publication, 1931: Physics and Physiology of the Acoustics of Buildings, particularly of the United Provinces Council Chamber, Lucknow. Being University Extension Lecture delivered on December 13, 1930, by Satyendra Ray at the Physics Lecture Theatre, University of Lucknow. Pp. 29. (Lucknow: Ward Memorial Committee.) 1 rupee; 1 dollar.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 68 (Radio Research Board Report No. 5): Atmospherics in Australia, I. By G. H. Munro and Dr. L. G. H. Huxley. Pp. 49. (Melbourne: H. J. Green.)

Journal of the Indian Institute of Science. Vol. 15A, Part 7: Studies in Indian Essential Oils; 1: Essential Oil from Leaves of *Litsæ Zeylanica*, Linn., by B. Sanjiva Rao; 2: Essential Oil from Flower-heads and Stalks of *Andropogon Kuntzeanus*, Hack, *Var. Foveolata*, Hack, by B. Sanjiva Rao; 3: Essential Oil from Leaves of *Thymus Serpyllum*, Linn., by Jagjit Singh and B. Sanjiva Rao; 4: Essential Oil from Leaves of *Cinnamomum Zeylanicum*, Breyn., by the late V. P. Shintre and B. Sanjiva Rao. Pp. 71–87. (Bangalore: Indian Institute of Science.) 1 rupee.

Investigations on the Spike-Disease of Sandal. 6: Report of Progress made during the Half-Year ending September 30, 1932. Edited by M. Sreenivasaya. Pp. 17. (Bangalore: Indian Institute of Science.)

The Pasteur Institute of Southern India, Coonoor. The Annual Report of the Director for the Year ending December 31, 1931, together with the Twenty-fifth Annual Report of the Central Committee of the Association for the Year ending March 31, 1932. Pp. 69. (Madras: Madras Publishing House.)

Department of Agriculture: Straits Settlements and Federated Malay States. Scientific Series, No. 10: An Examination of the Geology and Soils of an Area in the State of Perak. By H. E. F. Savage and R. G. H. Wilshaw. Pp. ii+16+5 plates. (Kuala Lumpur.) 50 cents.

Memoirs of the Punjab Irrigation Research Laboratory. Vol. 3, No. 1: An Analysis of the Utilization of Irrigation-Water in Typical Punjab Canals. By B. H. Wilsdon and Mehta Mukand Lal. Pp. 10+8 plates. (Lahore.) 8 annas; 9*d*.

Straits Settlements. Annual Report of the Director of Gardens for the Year 1931. By R. E. Holttum. Pp. 10. (Singapore.)

Proceedings of the American Philosophical Society. Vol. 71, No. 7. Pp. xx+411–427. (Philadelphia.)

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Financing Research

ONE of the commonest indictments of the financial structure in Great Britain as compared with, for example, Germany and the United States of America, has been the reluctance of our banking system to make advances for the financing of new industrial enterprises or the reconstruction on modern lines of established industries. There has, indeed, existed a definite gap in our national organisation, to which the Macmillan Committee directed attention, and to close which it suggested the development of a new body or Board of National Investment. Reference has frequently been made to this gap in recent months, notably in a letter to the Prime Minister from Mr. T. D. Barlow, the chairman of the Lancashire Industrial Development Council.

The unanimity with which, at recent general meetings of various important banks, the chairmen have been at pains to stress the importance of scientific research is accordingly the more remarkable and indeed startling, while Mr. J. W. Beaumont Pease, addressing the meeting of Lloyds Bank, made the significant statement that steps to form an organisation to close this gap in our financial structure are actually being taken.

Addressing the shareholders of Martins Bank Ltd. on January 24, Mr. A. A. Paton, for example, quoted examples of successful research in the cotton industry, particularly the recent discovery of a method of treating cotton cloth chemically which renders it practically indistinguishable from silk, and said that this result was directly due to research on scientific lines undertaken in Manchester. It may well establish cotton goods as a rival both to rayon and to silk, and substantially assist our export of cotton cloth in the finer qualities. "This success," said Mr. Paton, "should encourage all industrialists to recognise the important part that scientific research can play in the development and improvement of their production and lead them to a wider realisation of its value to them."

Mr. F. C. Goodenough's address to Barclays Bank Ltd. similarly asserted that the importance of research work in the advance of industry cannot be overestimated. The place to be assigned to the scientific worker in industry is, he said, a factor of the greatest importance which we cannot afford to overlook in the production of high quality goods. We must look forward to the development both of co-operation and individual effort in research if the craftsmanship of our workmen is to receive the maximum support of scientific knowledge in facing the present severe world competition. Similarly, the Hon. Rupert E. Beckett, addressing the Westminster Bank on February 2, asserted that we must endeavour by every means at our command to keep abreast of development in existing industries and take advantage of every opportunity to establish new industries. To allow industry to mark time would be fatal. We have a great reserve of scientific and inventive ability and it is essential that, faced as we are with shrinking markets for our products in many directions, we should utilise to the full any opportunities for new development which may be made available to us by scientific investigation. Mr. R. MacKenna's address to the Midland Bank on January 27 also referred to the great attention paid by many firms to scientific research, the value of which can scarcely be overstated, "though there is still room for great advance in this direction. The facilities for such research, through Government establishments, trade organisations and university institutions are greater than ever before and should be used to the full."

In the same strain Sir Christopher Needham told the District Bank Ltd. on January 27 that "A modern competitive industry must regard industrial and technical research as a necessary part of its very structure; only then will it be ready to take full and prompt advantage of improvements which scientific discovery reveals. The benefits of research are not necessarily restricted to big business, for any concern, great or small, which is wise enough to seek it can now find the essential help of this kind at its disposal." Of the cotton industry he added, "To-day more than ever before the cotton industry needs to know all that science can discover about the raw material it uses. The industry is singularly well served by its Research Association at the Shirley Institute and this co-operative effort of the industry to apply science to the production of cotton goods has been more than justified by results." He expressed the hope that the efforts of the scientific workers and technicians will receive that encouragement and help from the industry which they deserve.

Joining in the same chorus, Mr. G. P. Dewhurst also referred to the position in the cotton industry and told the Williams Deacon's Bank Ltd. on the same day that "Facilities for industrial research are available for all and science is fully capable of showing how processes of manufacture may be improved upon and persistent investigation to that end cannot fail to bring its reward".

Sir Harry Goschen's address to the National Provincial Bank Ltd. on January 26 referred to scientific research and the application of its results in industry as being at the root of our power to sell our goods and to meet the needs of our population so far as possible out of our own resources. Slow as the practical man in Great Britain has been on the whole to take full advantage of the products of the laboratory, the greater interest he is now taking in scientific activity is a happy augury for the future welfare of our people. There is room, Sir Harry said, for still closer contact between the industrialist and the scientific worker and this is provided by that useful organisation, the Department of Scientific and Industrial Research.

Mr. J. W. Beaumont Pease's contribution, as chairman of Lloyds Bank Ltd., is sufficiently important to merit quoting in detail. Admitting that a prime condition of industrial recovery is the solution of the difficult international financial problems which confront us, he asserted that that in itself would not ensure the return of prosperity to Great Britain unless we exercise the same resourcefulness and enterprise which our predecessors showed in no less difficult though somewhat different circumstances in the past. "To-day there is probably no direction affording a better prospect of rich reward than scientific discovery. It has to be remembered that the exercise of the native and untutored genius for improvisation and invention which in the past was sufficient to keep us in the van of progress is no longer sufficient. Economic production is to-day a highly expert business requiring the specialised training such as is possessed by the man of science. We must turn more and more to the research worker to point the way towards new advances and industry must realise that an efficient and well equipped research organisation is an essential element of good management."

Referring to the facilities for industrial research which are open to all in Government establishments, trade research associations and university institutions, Mr. Pease, in answer to the argument that only the larger and richer firms can finance such research, agreed that some organisation for providing finance for intermediate loans of modest amounts, and for comparatively short periods, which would fill the gap between ordinary banking loans and those of a longer duration and for rger sums, would be a desirable ado nancial machinery. Steps to form rganisation, he announced, are actually being aken.

The scientific worker may well rub his eyes in bewilderment and wonder whether the millennium has dawned! That the chairmen of eight large banks should speak in exactly the same strain and in the course of balanced and comprehensive surveys of the national position, in which due regard was had to all the other relevant factors, can scarcely be mere coincidence. The statements regarding the position and importance of research as a factor in national and industrial development could not be bettered and represent an outlook we have consistently urged in these columns for years past. Such sudden and mass conversion of a section of the community renowned for its conservatism cannot but quicken expectations of welcome and beneficial developments in national policy.

To whatever leaven this change of outlook is to be ascribed, whether to the educational work of the Department of Scientific and Industrial Research and other organisations, to the intensity of our present difficulties, or to increased contact with those responsible for developments in Germany, the United States, or Soviet Russia, undue optimism would be premature. On one hand, research is only one factor in new industrial development and the revival of trade is indeed only one of the fields in which scientific thought makes an important if not essential contribution. On the other hand, the present precarious position of the Research Association of British Rubber Manufacturers, which was discussed in NATURE of February 11 and 25, reminds us that industry is still very far from accepting research as a fixed charge comparable with obsolescence and insurance.

Plenty of evidence could be found that in other industries also, those in control have yet to learn that there is something to be gained by the application of the results of research. In the cotton industry, more co-operation is still required between the Shirley Institute and the technical staff in the industry. The scarcity of technical men on the directorates and boards of many industries is a common obstacle to the full appreciation of the value of scientific work, and research staffs are often the first to be cut down in times of panic.

There is, however, in such unanimity as is shown by the banking interests, at least the danger that over-emphasis may be laid on the assistance which scientific research can contribute towards recovery. Research is only one factor, and a great expansion in scientific and industrial research is more likely to contribute to our future prosperity than to the relief of our immediate difficulties. What is perhaps even more important at the present moment is that greater use should be made of the results of research already available, and that the scientific spirit and method should be more seriously and widely applied to assist in the handling of those difficult and intricate problems of management, production and distribution, on a national as well as on an international scale, with which industry and politics alike are confronted in a scientific age. It is to be hoped that the scientific outlook indicated in the eight addresses we have quoted will be reflected in the banks themselves according a place to scientific and technical opinion and advice in their counsels. It is only as such steps are taken that we can hope for the appropriate handling of the difficult problems which research inevitably brings in its train. It must be remembered that, from one point of view, scientific and industrial research disturb the stability of our economic and social order. Research tends to a dynamic society the ordering of which makes much greater demands on administrative ability than are made by a static order.

That scientific research should be commended in this manner is at least an encouraging sign. We may hope that such encomium will induce industry generally to apply more wholeheartedly and widely the results of research, to accord technical and scientific men a much more influential place in the conduct of its affairs, if not indeed to demand technical and commercial attainments as essential qualifications for a place on its boards of directors and management. We may hope, too, that the changed outlook will result in far more generous support for fundamental and long-range research, whether conducted in Government institutions or in the universities, upon which in the end even industrial progress depends. There is so much room for improvement in these matters that long before excessive effort has been expended on research, scientific workers themselves should be able to bring home to the community the essential fact that research is only one factor in recovery, one aspect of the fundamental problem of ordering the life of industry and of society in the light of reason and knowledge and not of prejudice.

Radio Communications by [illegible] Short Electric Waves

THE Marchese Marconi delivered the Friday evening discourse at the Royal Institution of Great Britain on December 2 and described his experimental investigations during the past year or two with electric waves less than one metre in wave-length. The systematic investigation of the properties and characteristics of these very short waves was taken up in view of the advantages which they seemed to offer in the field of practical radio communication, on account of the small dimensions of the apparatus necessary for emitting and receiving a considerable amount of electrical energy, combined with the freedom from interference due to electrical disturbances on such wave-lengths. At the commencement of his lecture, the Marchese Marconi referred to the fact that in 1896 he demonstrated the possibilities of short-distance wireless communication on a wave-length of about 30 cm., using a 'spark' transmitter and suitable reflectors. In the more recent work, a thermionic electron oscillator was employed, operating on the principle first demonstrated by Barkhausen and Kurz as a means of producing oscillations corresponding to wave-lengths of less than 100 cm.

DEVELOPMENT OF THE TRANSMITTING CIRCUIT

After testing, with varying success, all available receiving and amplifying valves with cylindrical electrodes used in the standard circuits, a special type of valve was developed, suitable for generating powerful oscillations under conditions leading to a reasonable life. These valves were made in pairs, as the mirror images of one another, and the basic circuit developed for their use is indicated in Fig. 1.

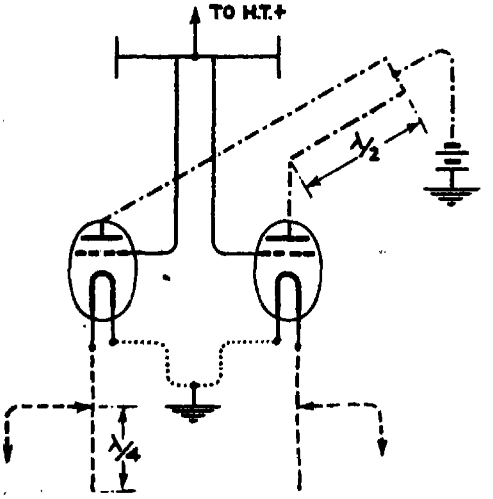

FIG. 1. Valve circuit for short-wave transmitter. Outside filament tuning - - - - ; inside filament tuning .... ; plate tuning -·-·-·- ; aerial and feeder impedance transformer ———.

This new electronic oscillator is characterised by three definite tuned circuits, namely, an inside and outside filament-tuning circuit and an anode-tuni circuit, and also by the use of a feeder-impedanc transformer, the purpose of the latter being t match the internal resistance of the valves wit that of an efficient dipole aerial. The small disc at the end of the dipole aerial act as end capacities, and experience has definitely indicated that their use secures more radiated power and renders easier the adjustment of the feeder-impedance-transformer than is otherwise possible.

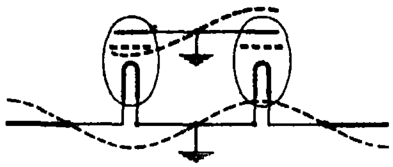

FIG. 2. Distribution of potential along filament tuning and plate tuning circuit.

The anode-tuning and the inside filament-tuning circuits are the controlling factors of the wave-length at which the transmitter can be made to oscillate with efficiency, all the other adjustments being dependent upon them. It is necessary to point out that the length of conductor required to connect the two anodes together for correct tuning is very small—it is only about 5 cm. for a wave-length of the order of 50 cm.—and the explanation of the fairly long kind of Lecher wire, shown in Fig. 1, is that it has been found possible and also desirable to add to that short conductor another conductor one wave-length long, bent back on itself to avoid loss by radiation.

The correct distribution of the potential along the plate and filament circuits, obtained by these tunings, is shown in Fig. 2. In addition to adjusting correctly all the external portions of the new circuit, it is necessary to arrange the electrical supplies to the valves employed so as to generate electronic oscillations between their electrodes at a frequency corresponding as closely as possible with that of the external circuits.

The radiated energy of one standard unit transmitter has been measured by placing the whole apparatus, except the aerial and feeder, in a calorimeter and taking temperature curves first with the transmitter in oscillation, and then in non-oscillating condition, all the electric currents being kept constant. Consistent results were obtained by this method indicating an average radiation power of 3·5 watts. The power absorbed by the filament was approximately 30 watts, that by the grid approximately 25 watts, the overall efficiency being, therefore, about six per cent, increasing to fourteen per cent, if the grid power only be taken into account.

The possibility of substantially increasing the radiating power of a transmitter was successfully realised by running several of these unit transmitters in parallel with their aerials all in line and spaced so as to secure the maximum directive effect.

Various methods of modulating the new transmitter were investigated, and the one finally adopted, chiefly on account of its simplicity, was that of superimposing the modulation on the steady negative bias voltage applied to the valve anodes. Where several transmitting units were connected together in correct phase, the anode circuits were connected in parallel and were thus modulated simultaneously. The anode-filament impedance of a unit transmitter has been measured and found to be about 2,500 ohms, and this value has been used in designing the modulating transformer.

WAVE-LENGTH MEASUREMENT

During the investigations, a practical form of wave-meter and radiation indicator was developed consisting of a dipole aerial provided with large discs to form end capacities. A standard type of thermo-milliammeter of low internal resistance was connected at the centre point of this aerial to indicate resonance with the radiated field from the transmitter. Wave-lengths of the order of 60 cm. could be measured to about 1 mm. by coupling the meter to an ordinary Lecher wire system, which, when in tune, reduced the oscillation in the meter to zero. After calibration in this manner the indicator was employed to adjust the transmitters to the working wave-length. In the case of the transmitters already described, it was found that by adjusting the external circuits and the electrical supplies, the standard valves were capable of generating oscillations at practically constant efficiency over a continuous range of wave-lengths of 80–50 cm. With the aid of other valves having smaller and shorter electrodes, a continuous wave-length range of 55–35 cm. could be covered at about the same efficiency.

REFLECTOR ARRANGEMENTS

The idea of utilising a system of unit reflectors followed logically on that of the system of unit transmitters just described. The advantages inherent in the possibility of placing side by side several transmitter units working in phase with each other for the purpose of increasing the power of a transmitting station, would, in fact, have been partly lost if the same method could not have been extended to the reflector.

Considering the type of multi-unit transmitter developed, it was decided to adopt the ordinary well-known cylindrical parabolic reflector, on the design of which a considerable amount of experience was already available. The high efficiency observed by experimenting with these very short waves with free end reflector rods in place of wires or rods supported at each end by insulators, leads to a peculiar type of construction where each reflector rod is supported at its middle point by a copper tube bent into a true parabolic curve.

The accompanying photograph (Fig. 3) illustrates the type of reflector adopted; this is economical in construction and has an important advantage in offering a small wind resistance. This system comprised four reflector units side by side, the aperture being three wave-lengths, and the focal length one quarter of a wave-length. The reflector rods were excited by three unit transmitting aerials, arranged along the focal line of the parabolic cylinder. Each transmitting aerial was located so as to overlap two adjacent reflector systems, this arrangement facilitating the correct phasing of the several transmitters. In this manner a directional transmitting system was provided in which the radiated energy concentrated in the forward beam was about 17 decibels above (about fifty times) that given by a half-wave dipole aerial alone.

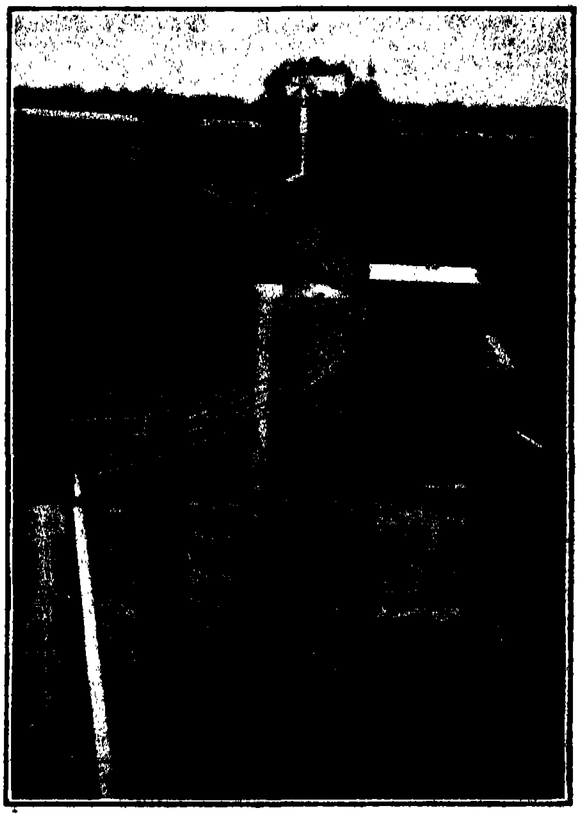
FIG. 3. Reflector system.

RANGES OBTAINED FOR PRACTICAL COMMUNICATION

After developing suitable receivers for the very short wave-lengths involved, a number of short-range communication tests were carried out during October and November, 1931, at distances of 11–23 miles oversea. In April 1932, a demonstration of duplex communication was given with equipment incorporating ordinary two-wire telephone terminal apparatus. This demonstration showed the practicability and resulting advantages of working both transmitter and receiver in the same reflector, and satisfactory two-way communication was maintained for several hours over the distance of 23 miles. Soon after this demonstration, the Vatican authorities decided to adopt this system for telephonic communication between the Vatican City and the Palace of the Pope at Castel Gondolfo, near Rome. The distance between these two points is more than twelve miles entirely overland, and the direct line between them is obscured by intervening trees. The apparatus has now been installed, however, and is giving satisfactory operation on what constitutes the first commercial radio link on a wave-length of less than one metre.

For the purpose of carrying out long distance tests, a more powerful transmitter was developed, comprising a five-unit reflector with a four-unit transmitter. A standard receiver with single reflector unit was installed on the yacht *Elettra*, and after preliminary tests over distances up to 28 miles, preparations were made for tests over longer ranges. The transmitting equipment was installed in an obsolete observatory at Rocca di Papa, near Rome, at a height of 2,500 ft. above sea-level and about fifteen miles inland. Under these conditions the maximum optical range as set by the curvature of the earth, for a rectilinear path between transmitter and receiver, was 52 miles.[*] In August 1932, duplex communication was established on a wave-length of 57 cm. between this station and the yacht at a distance of 18 miles. Satisfactory communication was continued at distances up to 58 miles, beyond which the signals became subject to slow and erratic fading, although they were still perceptible up to a distance of 110 miles.

After a repetition of the above test, in which the maximum range of perceptible signals was 125 miles, the receiving apparatus was installed on Cape Figari, Sardinia, at an altitude of 1,100 ft. above sea level. The distance between Rocca di Papa and Cape Figari is 168 miles whilst the optical distance, taking account of the heights of the two places, is only 72 miles.[*] When tested under these conditions, signals were immediately received from the transmitter, although they were subject to the same slow deep fading observed on the yacht. Excellent intelligible speech was received during the strong periods of the signals, but these became practically inaudible during the weak periods. This test lasted from about 4 P.M. until midnight, and the average signal strength appeared to be greater before than after sunset. On investigation at Cape Figari, it was found that the waves were arriving from a horizontal direction.

In conclusion, it may be said that these investigations serve to illustrate some of the practical possibilities of the application of electric waves, less than one metre in wave-length, in the field of radio communication. R. L. S.-R.

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[*] These values for the optical range, as given by the Marchese Marconi, do not appear to be correct. For the height of transmitter given, the range to sea-level is about 63 miles, while to the receiver at the height stated above, the optical range is 105 miles. It may also be pointed out here that ranges in excess of the optical distance have previously been obtained for radio telephonic communication on wave-lengths between 5 and 8 metres (see *Proc. Inst. Radio Eng.*, 19, 485, 1825, 1931).

Humour and Humanism in Baeyer's Laboratory

PROF. H. RUPE entered the private laboratory at Munich, as assistant to Baeyer, in 1891. At that date the great indigo problem had been solved, but the classical work on the reduction of the phthalic acids was still in full swing. These investigations, so well known in the abstract because of their bearing upon the constitution of benzene, take on at once a rich vesture of human interest to the reader of Prof. Rupe's delightful reminiscences of life in Baeyer's laboratory which have recently been published[*]. The work was beset with difficulties. At one time, for example, during the intensive search for dihydrophthalic acids, gigantic quantities of sodium amalgam, up to forty kilograms a week, were prepared and used in vain. The author remarks with feeling that the situation became very disagreeable to the assistants. It must have been, indeed, a "schwere, scheussliche und gefährliche Arbeit"; but no labour was too tedious for the Master and his band of devoted helpers. There was, as Prof. Rupe says, something of the magnificent in this prolonged contest with matter.

Eventually, however, even Baeyer was supersaturated with these hydrogenations ("übersättigt von diesen Hydrierungsarbeiten"), and the sorely tried assistants hailed with deep relief the transference of his interest to succinylosuccinic ester and diketocyclohexane. By means of a 'Kunstgriff' of which Baeyer was very proud (treatment with sodium amalgam in presence of sodium bicarbonate), the diketone was reduced to quinitol. At the first glimpse of the crystals of the new substance Baeyer ceremoniously raised his hat!

It must be explained here that the Master's famous greenish-black hat plays the part of a perpetual epithet in Prof. Rupe's narrative. As the celebrated sword pommel to Paracelsus, so the 'alte Melone' to Baeyer: the former was said to contain the vital mercury of the medieval philosophers; the latter certainly enshrined one of the keenest chemical intellects of the modern world. Hats are not associated as a rule with chemical research, although it is true that Trautschold's illustration (1842) shows the striking variety of headgear which was to be seen in

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[*] Adolf von Baeyer als Lehrer und Forscher: Erinnerungen aus seinem Privatlaboratorium. By Hans Rupe. (Sammlung chemischer und chemischtechnischer Vorträge, herausgegeben von Prof. Dr. H. Grossmann, Neue Folge, Heft 15). Pp. 26. (Stuttgart: Ferdinand Enke, 1932.) 2.50 gold marks.

Liebig's original laboratory at Giessen: these choice pieces, although perhaps not including an 'alte Melone', ranged from the postman's cap of Ortigosa the Mexican through the tam-o'-shanter of his unnamed neighbour to the stylish topper favoured by A. W. Hofmann. It now appears that the tradition of laboratory hats descended from Liebig to Baeyer. However that may be, Baeyer's head was normally covered. Only in moments of unusual excitement or elation did 'the Chef' remove his hat: apart from such occasions his shiny pate remained in permanent eclipse.

When, for example, the analysis of the important diacetylquinitol was found to be correct, Baeyer raised his hat in silent exultation. Soon afterwards the first dihydrobenzene was prepared, by heating dibromohexamethylene with quinoline: Baeyer ran excitedly to and fro in the laboratory, flourishing the 'alte Melone' and exclaiming: "Jetzt haben wir das erste Terpen, die Stammsubstanz der Terpene!" Such is the picture from behind the scenes of the dramatic way in which the Master entered upon his famous investigations on terpenes.

Incidents of this kind may appear to be slight, and yet cumulatively they throw a stream of light upon the personality of this great chemist. There is no doubt, for example, that at times 'the Chef' was unduly impulsive. One morning he burst into the private laboratory, and, without having lit his cigar (an indication in itself of unusual emotional disturbance), raised the ancient 'Melone' twice, and exclaimed: "Gentlemen [the audience was composed of Claisen and Brüning], I have just had word from E. Fischer that he has brought off the complete synthesis of glucose. This heralds the end of organic chemistry: let's finish off the terpenes, and only the smears ('Schmieren') will be left!" Prof. Rupe's reminiscences are rich in snapshots of this kind, which are often more revealing than pages of formal description could be.

Baeyer's customary tools were test-tubes, watch-glasses, and glass rods. As an example of his endless patience, Willstätter relates having seen him keep a test-tube in gentle play over a flame for three-quarters of an hour when activating magnesium with iodine. He valued at least three things which were deemed of fundamental importance by the alchemists; for he impressed upon his students that the essential attributes of the chemist are patience, money, and silence. His lectures were marked by clearness and simplicity of diction, with occasional delicate touches of North German humour or sarcasm. He urged his listeners to learn to think in terms of phenomena; and, like Kekulé, he emphasised the importance of giving occasional rein to the imagination: "so viele Chemiker haben nicht genügend Phantasie".

Although 'the Chef' was often regarded as stiff, unapproachable and severe, he was in reality a kindly man who did much good by stealth. He was free from vanity; and, unlike many men of learning, he was always ready to acknowledge ungrudgingly the merits of others. Baeyer favoured the use of simple apparatus, and the introduction into his laboratory of any device savouring of complexity had to be undertaken with great tact. The first mechanical stirrers, worked by water-turbines, were smuggled in one evening. On the following morning, 'der Alte' beheld them in full working order. For a time he affected to ignore them; then he contemplated them unwillingly, with an air of challenge; next came the first remark, so anxiously awaited: "Geht denn das?" "Jawohl, Herr Professor, ausgezeichnet, die Reduktionen sind schon bald fertig." The Herr Professor was finally so much impressed that he took the exceptional step of summoning the Frau Professor. 'Die Lydia,' as she was called in the laboratory, stood by the merrily clattering apparatus for a while in silent admiration; then she uttered these unforgettable words: "damit müsste man gut Mayonnaise machen können"! What a great deal depends upon one's point of view!

These truly fascinating pages afford glimpses also of the personnel surrounding 'the Chef'. Among them, Herr Leonhard, the old Bavarian factotum inherited by Baeyer from Liebig, stands out by reason of his liberal attitude towards the ethics of lecture demonstrations. Upon occasion he triumphed over his scruples to 'help' his experiments in their fight against the malignity of matter ("Tücke des Objektes")—that bane of the whole race of lecture-assistants: as witness his dry reply to a remark upon the difficulty of making chloroform from alcohol and bleaching powder: "Wissens Herr Doktor, dös Chloroform, dös is schon do herinnen"! There was also the old 'Laboratoriumdiener', Carl Gimmig, a veteran zouave of the war of 1870, with his compelling six-o'clock cry: "Ihr Herre, s'isch Zeit!" If the workers lingered, Carl remorselessly turned off the gas at the main and became 'terribly evident'. There is, too, an instantaneous snapshot of a 'filia hospitalis' of the laboratory, the fair daughter of Herr Inspektor Fehl; but of her it may be said, as of her prototype in the song so beloved of German studentry, that "die Füsschen laufen wie der Wind" off Prof. Rupe's pages.

A narrative of this kind cannot fail to reflect something of the personality of the author, and in the concluding relation of the surreptitious help he once extended to a would-be pharmacist, overcome with 'Examenangst' (expressive word!) in Baeyer's 'Bleikammer', we obtain a glimpse of Prof. Rupe's innate kindness of heart.

"Chemistry has always seemed to me such a *dead* subject—so utterly devoid of human interest!" exclaimed a classicist within the hearing of the present writer the other day, as he stepped somewhat reluctantly into a lecture on alchemy. May he and others who share that mistaken view seek a truer orientation in this matter from such writings as these sparkling reminiscences of life and labour in the laboratory of Adolf von Baeyer.

JOHN READ.

Obituary

SIR J. ARTHUR THOMSON

WITHIN two years of his retirement from the chair of natural history at the University of Aberdeen, Sir J. Arthur Thomson was struck down by a heart illness which had hampered his well-being for many years, and although he rallied, his power of resistance was broken and he died at his home at Limpsfield in Surrey on February 12, aged seventy-one years.

Born at Saltoun, East Lothian, on July 8, 1861, a son and grandson of the manse, Thomson graduated M.A. at the University of Edinburgh in 1880, and thereafter completed the divinity course at New College. But the influence of his teachers, and a natural bent derived from two generations of naturalists on his mother's side, swung the balance towards the study of natural science, and in 1883 he was at Jena under the guidance of Ernst Haeckel, and in 1885 with Schulze at the Zoological Institute in Berlin. He returned to Edinburgh to become the most popular teacher of his time in zoology and botany, and his success there led to his appointment in 1899 to the regius chair of natural history at Aberdeen. He was a good teacher, clear and sympathetic, never losing sight of the wood for the trees, insistent upon the broad truths to which the facts pointed; and so during these thirty-one years he kept turning out a stream of scientific workers remarkable in its volume for a small university recruited from schools where biology is unknown.

At the same time, Thomson was constantly engaged upon systematic investigations of the Alcyonaria, collections of which came to him for identification from almost all the seas of the world. The majority of his papers upon these collections were included in the reports of special expeditions, so that the mass of his descriptive work has been scarcely recognised; but although it was perhaps the least important of his great activities, it was very far from being negligible, as is witnessed by the extent of the collection of type and named specimens he presented to the British Museum on his retirement, and by the excellence of such memoirs as his accounts of the Alcyonaria of the Australian *Thetis* Expedition, of the Prince of Monaco's collection, and of the Dutch *Siboga* Expedition to the East Indies, the last of which appeared not many months ago.

Apart from his teaching, Thomson's great achievement was undoubtedly as an expositor of science and scientific thought. He had a gift of simple, lucid writing and lecturing, which enabled him from his full knowledge to expound the beauty and interest of Nature, so that no man of his time has done so much to interest the people in natural history. That was a work of importance, paving the way for that appreciation of scientific work which will allot to it its proper place in the life and progress of civilisation. He was in demand at home and abroad as a lecturer, and his lectures in book form, together with his other writings, make a considerable library in themselves. They were by no means all of the popular sort, and amongst the best I should be inclined to place "The Evolution of Sex" (1889) written with Patrick Geddes, "The Science of Life" (1899), a neat summary of biological progress, "The Wonder of Life" (1914), the St. Andrews Gifford lectures "The System of Animate Nature" (1920), the "Biology of Birds" (1923), and his last great work, written again with Geddes, "Life: Outlines of General Biology" (1931), a store-house of biological themes. On the popular side, the larger works which were probably most widely read were "The Outline of Science" which he edited and mostly wrote, and "The New Natural History".

Many honours came to Sir Arthur: he was invited to give several important series of lectures in Great Britain, in South Africa and America; he was created a knight on retirement from his chair, and then also Aberdeen made him an LL.D., a degree which had already been conferred upon him by his own University of Edinburgh, and by McGill University and University of California. Throughout it all he preserved a charmingly simple, almost shy demeanour, which hid a warm heart and much friendliness.

Sir Arthur Thomson could not have accomplished his vast output without the active assistance of Lady Thomson, herself a naturalist, and it is evidence of the strength of heredity and of the influence of early nurture, that each of the members of their family, three sons and a daughter, has contributed to scientific literature.

JAMES RITCHIE.

PROF. A. H. SAYCE

WITH the passing of Archibald Henry Sayce on February 4, Oxford loses one of the last, if not the last, of the old life-fellows, and the world a link with the scholars, of whom Sayce was by no means the least, who first deciphered the languages of the inscriptions of the old tongues of Mesopotamia and the surrounding regions, and so put on a firm basis the study of the ancient history of the Nearer East.

Sayce was in many respects a most remarkable man. He was born so far back as 1846, the oldest son of the Rev. H. S. Sayce, vicar of Caldicot, Mon., and even in undergraduate days had the misfortune to have bad health, but he was endowed with a remarkable persistence, and a scarcely less remarkable memory. He found the handling of heavy texts, lexicons and dictionaries an unpleasant task, and certainly for very many years abandoned their use, preferring to quote, not always perhaps accurately, from his well-stored memory. It is perhaps to this fact that we owe the enormous breadth of his learning, for he remembered all he read and up to the very last was reading and annotating with many linguistic parallels the latest current periodicals. He always moved with the times.

Sayce's early interests were mainly of a philological nature, including not only technical work on ancient languages, but also services to the revisers of the Old Testament, and a text and commentary on Herodotus. Later, he turned to questions of comparative religion, and when he was already more than sixty years of age, pure archæology especially attracted him. He acquired a very complete knowledge of modern work on prehistoric archæology, and the present writer remembers discussing with him, in his eightieth year—and it was Sayce who did most of the discussing—the problems of Mousterian and Upper Palæolithic flints in Transjordan. The geographical and scientific side of Assyriology was always of great interest to him, possibly owing to his early training under the Rev. Bradford Waring Gibson of Trinity College, Cambridge, a keen student of mathematics who was headmaster of Grosvenor College, Bath, where Sayce was educated. Unfortunately, apart from such publications as his "Notes on an Unexplored District of Northern Syria" in the *Proceedings of the Society of Biblical Archæology* of 1911, most of his geographical work is buried in former editions of the "Encyclopædia Britannica".

In addition to these wide interests, Sayce was an admirable preacher, and a pleasant and witty companion even to those widely separated from him in years, and it is sad to think that he no longer occupies the rooms in Queen's which he has had since he first became a fellow, nor shall we see any more the frail figure of our old friend walking along the sunny side of the Banbury Road on his way to visit one of his many pupils, for so we were, though he never gave and, indeed, of later years disliked, formal teaching.

Sayce obtained a first-class both in Moderations and Greats, taking his final Schools in 1868, a year which included Andrew Lang, E. A. Knox, afterwards Bishop of Manchester, T. Humphrey Ward, and K. A. Muir-Mackenzie. He obtained his fellowship in 1869, and was classical and theological tutor from 1870 until 1879. He was a member of the Old Testament Revision Company from 1874 until 1884, and deputy professor of comparative philology from 1876 until 1890; in the following year he became professor of Assyriology, and resigned in 1914. In 1897 he became president of the Society of Biblical Archæology, and retained this position until the Society was amalgamated with the Royal Asiatic Society in 1918. He was Hibbert lecturer in 1887, Gifford lecturer in 1902, when he discussed "The Conception of the Divine among the Egyptians and Babylonians", Rhind lecturer in 1907 and Huxley lecturer of the Royal Anthropological Institute in 1930. His honours were naturally mainly academic. His old University made him an Hon. D.Litt. in 1907, he was an honorary fellow of the British Academy and Hon. LL.D. of Dublin, and also held the honorary degree of D.D. at Edinburgh and Aberdeen.

It is not possible to recount Sayce's many publications. His first publications were Assyrian grammars; in 1874 he published "Principles of Comparative Philology" and six years later "Introduction to the Science of Language". Perhaps his best-known work is "Fresh Lights from the Monuments" which passed through no less than nine editions between 1883 and 1895, while his standard book on the Old Testament was "'Higher Criticism' and the Verdict of the Monuments" (1894). This does not include a host of other books and articles, some of which have been mentioned above, for, during his long working life, scarcely a year passed without an important contribution from his pen dealing with some aspect of Assyriology. L. H. D. B.

MR. T. A. COWARD

THE sudden death from heart failure of Thomas Alfred Coward at his home at Bowdon on January 28 leaves a gap in the ranks of British field naturalists and came as a blow to those who knew and loved him.

Coward was born in Bowdon, a Cheshire suburb of Manchester, in January 1867, and there he spent his life. Educated at Brooklands School, Sale, and Owens College, Manchester, he endured nineteen years in the uncongenial atmosphere of a Manchester warehouse, until the absorption by one of the large industrial combines of the firm which he was serving gave him the chance he craved, and for more than thirty years he was able to follow his own bent in studying animals, particularly vertebrates, in the field. He contributed occasional notes and papers to the *Proceedings of the Zoological Society*, to the *Zoologist*, *British Birds* and other more or less technical magazines. Articles in the *Field* and other newspapers and in the *Nineteenth Century* appealed to a larger public, and as "T. A. C." of the *Manchester Guardian* he was widely known.

Of Coward's many books on topography and natural history, the most serious contribution to scientific literature was perhaps the "Vertebrate Fauna of Cheshire and Liverpool Bay" (1912), which ranks high among county faunas, but better known is his "Birds of the British Isles and their Eggs", first issued in 1919, a household word among amateur ornithologists, which has done more to promote and encourage the intelligent study of birds in Great Britain than any other work of our time. To study birds he went to many out of the way parts of Britain from the Shetland Isles to Cornwall, and with his wife, who shared his tastes, visited Holland, the Camargue, the Pyrenees and Hungary in order to find birds he could not see at home.

What Coward wrote was always good reading. It was mostly the outcome of his own wide and varied experience, was free alike from technicalities and rhetorical frippery, and above all was accurate. He had a considerable vogue as a lecturer and his lectures and broadcast talks were compact of the same sound material as his writings. For more than a quarter of a century he was a distinctly educative force.

During the War, Coward was acting keeper of the Manchester Museum, and in 1921 the University conferred upon him the degree of M.Sc. in recognition of his services in that capacity. He was an active member of the Museum Committee, and devoted much time to the arrangement and care of the Dresser collection of birds. He was a member of the executive committee of the Lancashire and Cheshire Fauna Committee, and acted as referee for vertebrates. He was president of the Manchester Literary and Philosophical Society in 1921 and 1922 and a fellow of the Zoological and Entomological Societies.

C. O.

Mr. Henry A. Fleuss

We regret to announce the death on January 4, at the age of eighty-two years, of Mr. Henry Albert Fleuss. He was one of the pioneers of rescue apparatus. After serving in the mercantile service for many years, he left it about 1879, in order to make a pipeless diving apparatus. He designed a suitable pump for compressing oxygen and made his first test in a tank at the old Polytechnic in Regent St., London. Without any previous experience of diving, he remained under water for one hour, which at that time was an amazing performance.

Fleuss claimed to be the first man to breathe pure oxygen without any ill-effects. At the request of Sir B. W. Richardson, he went into a chamber filled with a gas that meant death in one minute if inhaled, and stayed in there for half an hour. Later, during a lecture given by Sir B. W. Richardson, Fleuss remained in a chamber through which a current of carbon dioxide was made to flow.

Fleuss then turned his attention to mine rescue apparatus and carried out experiments at the Netherseal Colliery and Seaham Colliery. His next exploit was during the building of the Severn Tunnel, the workings of which became flooded. Fleuss went down a shaft 200 ft. deep with 40 ft. of water at the bottom, and was given up for dead a long time before he returned to the surface. The celebrated diver Lambert then put on the dress and was able to close the necessary doors to enable the tunnel to be pumped out. Messrs. Siebe, Gorman and Co., Ltd., afterwards put the apparatus on the market.

Among Fleuss's other inventions was the well-known 'Geryk' vacuum pump. He claimed to be the inventor of the first mechanical high efficiency vacuum pump ever made, in 1885. About 1890 at a demonstration at the Royal Institution an electric lamp bulb was exhausted with a 'Geryk' pump, and the lamp burned for about 1,000 hours.

Fleuss also invented a tubeless pneumatic tyre which was in great demand about thirty-five years ago.

W. G.

Dr. Willy Merck

We regret to learn from the *Chemiker-Zeitung* of the death on December 15 of Dr. Willy Merck, a member of the well-known firm of chemical manufacturers, E. Merck of Darmstadt. Dr. Merck, who was born in 1860 at Darmstadt, was the son of Dr. Georg Franz Merck, the discoverer of papaverine. After studying at the Universities of Heidelberg, Strasbourg and Kiel and at the Polytechnic at Aachen, he graduated at Kiel in 1886, where he had worked under the direction of Ladenburg. His thesis embodied the results of his studies on cocaine and he had been able to effect a partial synthesis of this alkaloid by the methylation of benzoylecgonin, a by-product obtained during the extraction of cocaine. Many years later, the complete synthesis of naturally occurring *l*-cocaine and of *d*-pseudococaine was carried out in the Merck laboratories by W. Merck in collaboration with R. Willstätter.

Immediately after his graduation, Merck entered the service of the firm and, after a year's travel in the Far East, he returned to Darmstadt to undertake a leading part in directing the work not only in the laboratories but also in the factory, where he successfully initiated the manufacture of many new drugs. In 1905 the University of Halle conferred upon him an honorary doctorate in the Faculty of Medicine and he was the recipient of many public honours and decorations. He was made *Geheimer Kommerzienrat* in 1918 on the occasion of the two hundred and fiftieth anniversary of the foundation of the firm.

The death on February 5 is announced of Mr. J. J. F.-X. King, aged seventy-seven years, one of the best-known Scottish entomologists. Mr. King was an accomplished field naturalist and collector, and some few years ago he presented his main collection of British insects to the University of Glasgow. The University is now to receive under his will the portrait of Mr. King painted by Forrester Wilson and the remainder of his collections, together with his library of books on natural history.

We regret to announce the following deaths:

Dr. C. A. Barber, C.I.E., lately lecturer in tropical agriculture at the University of Cambridge, formerly Government Botanist, Madras and Sugar Cane Expert for India, on February 24, aged seventy-two years.

Sir Benjamin Gott, chairman of the Commission on Educational and Cultural Films, who was secretary of the Middlesex Education Committee from 1898 until 1928, and formerly headmaster of the Cheltenham School of Science, aged sixty-seven years.

Prof. Johannes Schmidt, director of the Carlsberg Physiological Laboratory, Copenhagen, a leader of several deep-sea expeditions, and known especially for his work on the life-history of the eel, aged fifty-five years.

News and Views

The Pepys Tercentenary

ON February 23 the tercentenary of the birth of Samuel Pepys was commemorated in London and at Cambridge. The London celebrations included a lecture by Mr. E. Chappell arranged by the Society for Nautical Research at the Clothworkers' Hall; an address by Mr. A. Bryant to the Women's Section of the London Municipal Society at Admiralty House, and a commemoration service at the Church of St. Olave, Hart Street, where Pepys was buried and close to where he lived and worked. The service was attended by the Lord Mayor and sheriffs of the City of London and the address was given by Prebendary Wellard, chaplain to the Pepys Club. During the service a wreath was placed on the Pepys monument. At the meeting of the Royal Society in the afternoon, the fellows stood in silence as a tribute to the memory of Pepys, and the president, Sir F. Gowland Hopkins, recalled that they met on the actual date of Pepys's birth, three hundred years ago. Though Pepys, he said, was not an investigator, it was clear his business acumen and his general interests in their problems had put him high in the estimation of his contemporaries, as he was thrice elected to the council and ultimately to the presidential chair. The references in his "Diary" to the Society showed his appreciation of the privileges of a fellow and his interest in the Society's work. The commemoration at Magdalene College, Cambridge, was attended by Sir John Simon, who proposed "The Immortal Memory of Samuel Pepys".

Samuel Pepys and the Royal Society

IT was recorded in NATURE of February 18, p. 229, that Pepys, after an interval of non-service, re-entered the council of the Royal Society at the anniversary meeting on November 30, 1681, Sir Christopher Wren being president. At the anniversary meeting in 1684, Pepys became the Society's president, and it is of interest to note the frequency or otherwise of his attendances at council meetings, or at the general gatherings afterwards in Gresham College, for discourse, or for experimental purposes of the kind then possible. When presiding at councils Pepys did not always remain for these later meetings, and the reason may doubtless be found in his numerous public duties, but, as substitute, Dr. Gale, Sir John Hoskyns, Dr. Lister, and Sir Joseph Williamson were often called upon in turn. Pepys was not present at the Society's meeting on December 3, 1684, but he attended the council on December 10, as well as presiding at the subsequent meeting of fellows. From the following January 7, until September 18, he attended three councils and one meeting. He was continued on November 30, 1685, in the presidency for another year, and during that period he attended eight council meetings and three ordinary meetings. On November 30, 1686, the Earl of Carbery was made president, and Pepys a vice-president. Opportunity may here be taken to record that Sir Anthony Deane, the eminent ship designer, and co-adjutor of Pepys in naval matters, who was made a fellow of the Society in 1681, was elected to the council on November 30, 1682. At the anniversary of 1684, when Pepys became president, Sir Anthony Deane re-entered the council; thus the two were colleagues. We may, perhaps, believe that Deane owed his entry to Pepys's recommendation.

Number 60 in Time Measurements

A CORRESPONDENT has sent an inquiry as to the origin of the division of a day into twenty-four hours, each divided into sixty minutes, and these into sixty seconds. The preliminary observation may be made that the numbers five and twelve are both marked out naturally by the fingers on our hands and the months in the year; it is not surprising that their product should be selected as a convenient number. Sixty is also twice the number of days in a month, the length of the average lunar month being a little less than thirty days, and that of the average solar month a little more than thirty. John Williams, on p. 17 of his "Chinese Observations of Comets", describes the Chinese reckoning of time by cycles of sixty years and smaller cycles of sixty days, the same system of names being used for the individual years and days of a sixty-fold cycle. Possibly they used the divisor sixty again in forming smaller time-intervals. It is, however, probable that our present subdivisions of time are derived from countries less remote than China. The independence of ancient China from western nations is shown by the completely different division of the stars into constellations that was adopted there.

DR. J. K. FOTHERINGHAM gave some details of the divisions of time in use in ancient Mesopotamia at the November meeting of the Royal Astronomical Society (*Observatory*, December 1932). There were twelve months, each of about thirty days, in an ordinary year. The Sumerians divided a day into twelve *beru*, each *beru* into thirty *uš*, thus following the analogy of months and days; incidentally, this gives the origin of the division of the circumference of a circle into 360°, or twelve signs of 30° each. Dr. Fotheringham states that the Babylonians afterwards divided day and night each into twelve hours, which changed in length with the seasons. The Egyptians also followed this arrangement. Moreover, sixty was an important number in the Chaldean system of numeration, so that it was natural to use it in subdividing the hour into sixty minutes, and, at a later date, in dividing the minute into sixty seconds. The latter unit was unimportant until fairly accurate clocks had been constructed.

Gift to Herbarium of University of Bristol

MR. J. W. WHITE, the Bristol field botanist, who died on October 26 last, bequeathed the whole of his British and Continental herbarium and a hundred valuable books to the Botany Department of the University of Bristol. The whole herbarium is made up of about 15,000 sheets of which those carrying British species occupy six, and those carrying Continental European species occupy fifteen large cabinets. Most of the plants in this herbarium were collected by White himself on his walks and travels at home and abroad, but numerous additions have from time to time been made by exchange and purchase. The specimens are beautifully mounted, well labelled, carefully catalogued and useful notes and relevant cuttings are frequently attached to the sheets. White was the author of "The Flora of Bristol", published in 1912, which is rightly considered a model of what a county flora should be. His herbarium is, however, of far more than merely local importance. The accuracy and critical nature of his determinations make it of real scientific value and wide general interest. By coming into possession of this herbarium the *hortus siccus* of the University of Bristol has become one of the four best-equipped university herbaria in England.

Verulamium, 1932

EXCAVATIONS at St. Albans in 1932, of which Dr. and Mrs. R. E. Mortimer Wheeler gave an account at the Society of Antiquaries on February 23, have again added to the impressiveness of the prehistoric site and enhanced its importance as a source of knowledge of conditions in Britain immediately before the Roman invasion. The chance discovery in 1932 of a hoard of silver coins a mile north of the Abbey in the dyke running across country from the north of St. Albans in the direction of the village of Sandridge, not only proved the existence of the dyke before the second century A.D., but also led to the determination of the true character of this remarkable work, which is 100 ft. broad, 30–40 ft. deep and some five miles long, as a British defensive work extending from the pre-Roman city at the south-west of St. Albans to prehistoric works, of which the remains are still to be seen at Wheathampstead. Excavations here in the past summer have shown this to be a prehistoric 'city' about a hundred acres in extent, the most remarkable of its kind in the period yet found in Britain. It would appear that this great work was constructed by the Belgic invaders of Britain, who established their headquarters at St. Albans towards the end of the first century B.C. In his account of the past year's exploration of the Roman city, Dr. Wheeler drew a gloomy picture of the social and economic depression, alleviated only by a brief and illusory recovery, which invaded Verulamium as Roman power declined, after a brilliant and perhaps too optimistic efflorescence of prosperity. In the juxtaposition of pre-Roman and Roman on an extensive scale and in the evidence of the varied fortunes of a prolonged Roman occupation, St. Albans, under continued exploration, promises to become one of the most instructive and impressive archæological sites on the fringe of the Roman Empire in the western world.

Federal Council for Chemistry

IN its report for 1932, the Federal Council for Chemistry refers with regret to the necessary postponement of the ninth International Congress of Pure and Applied Chemistry and the eleventh conference of the International Union of Chemistry, which were to have been held in Madrid in 1932. The next meeting of the Union will take place in the spring of 1934 in Madrid, and not in Switzerland, as previously arranged. During the year, the Verein Oesterreichischer Chemiker and the Svenska National Kommitten för Kemie were elected members of the International Union. The report refers to a conference on chemical documentation, held in Paris in October 1932, and indicates that the Federal Council and the Division of Chemistry and Chemical Technology of the U.S. National Research Council are in complete agreement with regard to certain criticisms of the activities of the International Committee dealing with the reform of biochemical nomenclature. The efforts of the British Standards Institution to extend the use of the words "British Standard" to include "chemical substances used in manufactures, photography, or philosophic research and anti-corrosives" were supported by the Federal Council. The Board of Trade agreed to the Institution proceeding with an application to register provided that it was in a position to submit support from the appropriate trade association or similar body. A significant passage in the report is as follows: "In October, a Committee consisting of Dr. E. F. Armstrong, Mr. E. R. Bolton, Dr. L. H. Lampitt, Prof. G. T. Morgan, Mr. Emile Mond, Prof. J. C. Philip, Sir William Pope, Mr. J. Davidson Pratt, and Mr. D. Rintoul was appointed 'To consider how the resources of the various bodies concerned with the professional and scientific welfare of chemists can be most economically and efficiently utilised'. This Committee has met on several occasions, and will present, early in 1933, a report on its findings for consideration by the Federal Council." We shall look forward with interest and expectation to the outcome of the deliberations of so representative a committee, which is dealing with a matter of national as well as professional importance.

Photographic Analysis of Explosion Flames

AT the Friday evening discourse at the Royal Institution on February 24, Prof. W. A. Bone discussed "The Photographic Analysis of Explosion Flames". Nowadays the photographic analysis of explosion flames has become an indispensable part of the scientific study of explosions. Prof. Bone described first, with experimental illustrations, how the earlier work of Mallard and Le Chatelier and of Berthelot and Vieille in France, as well as that of H. B. Dixon and his collaborators in Great Britain, during the period 1883–1903, revealed, not only the successive stages in gaseous explosions, but also much about the nature of the final phase of 'detonation' (*l'onde explosive*) with its intensive chemical action, high constant velocities (one or two metres per second) and shattering effects. Prof. Bone then dealt principally with recent developments in the designing of high-speed cameras by Mr. R. P. Fraser at the Imperial College, South Kensington, where it has now become possible not only to photograph, but also to analyse with precision, periodic movements in explosion flames occurring with frequencies up to a million a second. A number of the resulting photographs were exhibited showing the influence of compression waves in accelerating explosion flames and setting up detonation therein and, more particularly, the new phenomenon of 'spin' in detonation, which is due to a highly luminous comet-like 'head' of detonation spiralling through the medium with a frequency of several tens of thousands a second, and appears to be a concentrated locus of positively charged particles. These developments are not merely important but have also opened up a new field in the investigation of the propagation of chemical change through gaseous media under the most intensive conditions of temperature and pressure.

Recent Acquisitions at the British Museum (Natural History)

THE Rev. A. H. Cooke has given the whole of his collection of shells of land-snails of the genus *Clausilia* and of the dog whelk (*Thais lapillus*); the former is very rich in series from central Europe and the Balkans, and the latter includes specimens from practically the whole distributional area, and illustrates very completely the remarkable variation of this species. Recent accessions to the Department of Entomology include the final instalment, consisting of several hundred Hymenoptera, of the very large amount of material collected by the Percy Sladen Trust Expedition to the Seychelles and other islands of the western Indian Ocean. This expedition, which was led by Prof. (then Mr.) Stanley Gardiner, in 1905 and 1908–9, resulted in the gift of many thousands of specimens to the Museum. The final instalment consists almost entirely of small or minute wasps, many of them obviously new, which it has so far proved impossible to work out owing to the lack of specialists in these groups. The Department has also received a set of the Hymenoptera collected on the island of Rodriguez by the late H. J. Snell and by Mr. H. P. Thomasset. From Mount Kina Balu in North Borneo a series of a new species of *Blepharocera* has been sent by Mr. H. M. Pendlebury. Flies of this genus have hitherto been found only in the north temperate regions, and their discovery in Borneo is therefore both surprising and of importance in zoogeography. The larvæ of these insects live only in waterfalls and rapids, attaching themselves to rocks and stones by means of ventral suckers; and it has been considered therefore that they would be able to spread only along land routes. The four, widely separated, compound eyes in this species give the head a most remarkable appearance. The American Museum of Natural History has presented to the Department of Geology a model of an extinct straight-tusked elephant.

Game Animals in the British Museum (Natural History)

THE Trustees of the British Museum announce the closing of the exhibition of the game animals of the British Empire in the New Whale Gallery at the Natural History Museum on March 19. As, owing to the financial stringency, it was impracticable to begin last year the removal of the exhibited specimens of whales to their new quarters, the Trustees decided to use the space available for the temporary exhibition of the game animals, grouped by the three great faunal regions in which they occur and arranged without glazed cases. Unhappily the skins are attractive to moths; it would therefore be risky to leave the specimens exposed when the moths begin to fly in spite of the daily dusting which these skins receive, and they will be returned to their cases before the end of the month. Capt. Guy Dollman, who was responsible for the arrangement of the exhibition, will talk in the New Whale Gallery about the animals in the three great faunal regions at 11.30 on March 4, Indo-Malaya; March 11, Africa; March 18, Canada and Newfoundland. Visitors will be admitted free.

Ross Institute for Tropical Diseases

AT a recent meeting of the Industrial Advisory Committee of the Ross Institute, Putney Heath, London, S.W., reports were received of the over-seas activities of the Institute. Seven research centres in Assam and northern Bengal have been opened, and anti-malarial work and the testing of new drugs for the treatment of malaria have been pursued there and in Rhodesia and East and South Africa. In the Assam tea gardens, anti-malarial work has resulted in much improved health, for in 1930 among a population of 13,248 the admissions to hospital were 23,226 but in 1932 with a slightly larger population the admissions were reduced to 15,141. A standard oil mixture for killing mosquito larvæ has been devised in conjunction with the Burma-Shell group. The health among lead miners in Yugoslavia was investigated and a health scheme was formulated and is now in operation. At the conclusion of the proceedings, Mr. Still and Sir Malcolm Watson addressed the meeting on the subject of yellow fever. Now that travel by aeroplane is so rapid, the grave danger that infection may be carried from the yellow fever zone in West Africa to East Africa and Asia, which would be followed with disastrous consequences, was emphasised.

Norwegian Antarctic Expedition

CAPT. H. RIISER-LARSEN, the leader of the forthcoming Norwegian expedition to the antarctic, has outlined his plans in the *Polar Record* for January. With two companions and eighty dogs, he hopes to be landed from a whaler at Enderby Land early this year. A hut will be built as a base for the winter months but various sledge journeys will be made in April and May. In the spring the three men will start sledging westward over the sea-ice along the coast of the Weddell Sea to Snow Hill or Hope Bay in Graham Land, where supplies were to be landed by a whaler this (southern) summer. The expedition is to be picked up early in 1934. A short wave radio equipment will be carried which will make it possible for arrangements with the whaler to be altered. Capt. Riiser-Larsen believes, from his view of the ice during flights in recent years, that the land-ice round this coast is heavily crevassed and would make travelling difficult. On the other hand, he thinks that the sea-ice will give a suitable surface and that lines of stranded bergs prevent it breaking up near the coast. The experience of others in the Weddell Sea suggests that these are optimistic views, but Capt. Riiser-Larsen admits that if the route proves impracticable, journeys will be made in an easterly direction from Enderby Land, where there is much work to be done. The use of a sea-ice route will certainly allow plenty of seal-meat to be got for men and dogs, and so obviate the necessity of carrying full rations.

Institution of Mechanical Engineers

At the annual general meeting of the Institution of Mechanical Engineers on February 17, Mr. A. E. L. Chorlton, M.P., was inducted as president and the annual report for 1932 was adopted. The total membership of the Institution is now 11,295, a net increase for the year of 134. While the numbers of associate members and graduates show considerable increases, there has been a decrease in the numbers of members and of students. During the year Sir Alfred Ewing, Sir Henry Fowler, Sir Vincent Raven, Sir J. J. Thomson and the late Mr. W. H. Patchell were elected honorary life members. The total revenue for the year was £34,052. The report refers to the work of the various research committees and also to the educational work done. Examinations for National Certificates and Diplomas in Mechanical Engineering were held in conjunction with the education departments in England, Scotland and Northern Ireland at which 2,829 candidates sat. Twenty National Diplomas (Air) in Mechanical Engineering were awarded jointly with the Board of Education and the Air Ministry to officers of the Royal Air Force on completion of the engineering course at Henlow. In addition to the meetings held at the headquarters of the Institution, full programmes were carried out by the nine provincial branches, the average attendance of members and visitors at each meeting being more than a hundred. The gifts to the Institution include a plaque modelled by F. J. Halnon and cast in steel, showing Faraday in his laboratory, the donor being Sir Robert Hadfield.

Illuminated Fountains

Recent installations of illuminated fountains in Paris and Stockholm prove that magnificent effects can be produced in this way which fit in well with festive occasions. In the *Escher-Wyss News* for October an interesting technical description is given of an illuminated fountain which was constructed in the lake of Zurich for a 'lighting week'. A pontoon was moored 85 metres distant from the shore and away from the route of the steamers. The caisson is circular in shape, its weight is 12 tons and the upper platform is ten metres in diameter. Five pump sets are arranged in the bottom of the caisson each capable of delivering 220 lb. of water per second when the motors rotate at 1,450 r.p.m., producing a total pressure head of 20 metres. They can be connected in series or parallel. The play of the water is arranged in eight different ways producing the appearance of circles, tulips, baskets, etc. With one arrangement the main water jet rises to a height of 45 metres, the whole fountain being apparently enveloped in foam. The whole of the playing waters are illuminated by thirty-two search-lights, each taking between 1,000 and 1,500 watts. The lamps are hermetically sealed in concrete casings. The entire pontoon is painted in a neutral colour so as not to form a contrast and interfere with the picture presented by the lake. The general effect of this fountain fits in very well with the shore illuminations. The work was completed in a few weeks and the fountain was set in operation on October 1, 1932.

Steam, Electric and Diesel-Electric Traction

In a paper read before the Institution of Civil Engineers on February 21, H. W. H. Richards, electrical engineer to the London and North Eastern Railway, makes a definite comparison, both technical and financial, between steam, electric and Diesel-electric traction. The comparison is based on the existing traffic conditions of load and speed, so that it is on exactly the same basis in each case. It can be shown that the most satisfactory unit to adopt is the trailing ton-mile per annum per single track. The average traffic density for steam trains is about three million ton-miles and for electric trains which are practically confined to suburban service it is about 4·5 million ton-miles. It appears that on an average load of about fifty per cent for the complete electrification of the main lines in Great Britain, the total power of the steam turbines required for the electric service would be 3·5 million brake horse power. If Diesel-electric service were adopted throughout, the total Diesel engine power required would be 15 million brake horse power. On the same basis, the total weight of electric tractors would amount to 850 thousand tons as compared with 1,300 thousand tons for Diesel-electric tractors. The capital costs for traffic densities ranging from 2 million to 10 million ton-miles are in all cases cheapest for steam and the costs of electric and Diesel-electric services are much the same at a traffic density of 4 million, after which electric traction becomes progressively cheaper. As regards operating costs, for main line services, including interest on capital, the cost of electric traction is lower than that of steam or Diesel-electric traction at traffic densities greater than 2·5 million ton-miles.

Reading under Vibratory Conditions

In the paper on recent developments on electric lighting read by Mr. W. J. Jones to the Royal Society of Arts on November 30 and published in the Society's journal (*J. Roy. Soc. Arts*, vol. 81, p. 132) some novel experiments and phenomena were described in connexion with illumination. He showed a swinging pendulum with the letter *E* printed at various points down its shaft. The speed of translation of any particular *E* is directly proportional to its distance from the point of suspension. When the illumination on the pendulum was only two foot candles, the letter *E* could only be seen about a quarter of the way down the pendulum. But when the illumination was increased to 100 foot candles the letter *E* could be seen almost at the bottom of the pendulum. A connexion can thus be obtained between the speed of vision and illumination. Experiments were described on the effect produced by the vibration of public vehicles. When the vehicle was moving, an appreciable reduction both in the speed of reading and in visual acuity took place. Experiments made a few years ago by reading a newspaper in a train on the Bakerloo Railway when it was at rest and when it was running showed that in the former case the speed of reading was 220 words a minute and in the latter 140 words a minute. In this case the illumination was two foot candles. Tests carried out in trains and buses under similar conditions about the same time gave similar results, showing that there was an appreciable reduction in the speed of reading when the vehicle is in motion. Reading under vibratory conditions in a poor light is known to cause visual fatigue and is apt to produce headaches. We are glad to hear that in some of the London Underground railway coaches to-day, the illumination at reading level has been raised to about twenty foot candles. This automatically does much to mitigate the effects of vibration, so far as visual performance and comfort are concerned.

English Folk Dance and Song Society

THE recent amalgamation of the Folk Song Society with the English Folk Dance Society has been marked by the appearance of a new journal with the title *Journal of the English Folk Dance and Song Society*, under the editorship of Mr. Frank Howes. The contents of the first number are indicative of the policy which it is now considered desirable for the reorganised societies to pursue in common. The primary object which the original societies had in view was the collection and preservation of the remains of traditional songs and dances. This work now being regarded as completed, so far as can be seen, the main work of the joint society on its scientific side will be intensive comparative study of the material which has been collected. In the first issue both activities, it is true, are represented. Ten more of the forty Gaelic songs collected by Miss Lucy Broadwood twenty-five years ago are published, as well as some English folk songs and dances recently recorded. On the comparative side, Mr. A. G. Gilchrist makes an exhaustive study of the Scottish and Northumbrian ballad Lambkin, discussing its growth and origin in the light of some forty versions. Similar studies of no little interest to students of culture and of 'survivals' and their distribution are Miss Violet Alford's record of the form and distribution of the Farandole in the south of France and in Spain and the study of the sword-dance by Dr. R. Wolfram of Vienna, who connects it with the initiation ceremony, seeing in the decapitation of the 'fool' the ritual death of initiation rather than the memory of a fertility sacrifice.

Sadi Carnot, 1796–1832

IN *La Nature* of February 1, under the title "Grandeur et Modestie d'un savant Français: Sadi Carnot", M. Roger Vène gives a sketch of the life and character of the young French engineer who wrote the famous essay "Réflexions sur la puissance motrice du feu". Carnot was only twenty-eight years of age when he published the essay, and he died of cholera eight years later. According to the regulations, the clothes and papers belonging to the victims of the cholera epidemic which swept through Paris in 1832 were to be destroyed, but fortunately some of Carnot's manuscripts were saved by his friend Clapeyron. Born in the Petit Luxembourg when his father, Lazare Carnot, was a member of the Directory, Sadi had a brilliant career as a student of the Ecole Polytechnique but was too young to take part in the Napoleonic Wars, and his life was spent mainly in the routine of the barracks. The extracts given by M. Vène reveal a charming personality. The article is accompanied by a portrait of Carnot at the age of seventeen years. An article on Carnot appeared in our columns on August 20, 1932 (p. 266).

Plant Pathology at Rothamsted Experimental Station

THE Committee of Management of the Rothamsted Experimental Station recently decided to reorganise the old Department of Mycology, started in 1918 under the charge of Dr. W. B. Brierley, now professor of agricultural botany at the University of Reading, and to constitute it a Department of Plant Pathology with Dr. J. Henderson Smith as head. Dr. Henderson Smith studied medicine at Balliol College, Oxford, and then proceeded to the University of Edinburgh, where he took his medical degree; he was then awarded the Philip Walker studentship in pathology, which he held at Oxford until his appointment first as bacteriologist at the Lister Institute and afterwards as plant pathologist in the Mycology Department at Rothamsted. He has published numerous papers on animal pathology, especially immunity and bacteriology, and on plant pathology, especially virus diseases.

Motor-Car Speed Record

ON February 22, Sir Malcolm Campbell broke his own motor-car speed record on Daytona Beach, Florida, in his car the *Blue Bird*. On the southward run Sir Malcolm covered the mile in 13·16 sec. and in the northern run in 13·60 sec. His mean speed worked out at 272·108 miles per hour, thus being well ahead of his record of 253·978 miles per hour set up last year. The *Blue Bird* is fitted with a Rolls-Royce engine developing 2,350 H.P. at 3,200 R.M.P. The engine has a bore of 6 in. and a stroke of 6·6 in. This type of engine was also installed in the aeroplane which won the Schneider Trophy for Great Britain and in the machine in which Flight-Lieut. Stainforth achieved the world's present air speed record of 407·5 miles per hour.

British Fresh-Water Fishes

THE Trustees of the British Museum have published a second edition of their "Guide to the British

Fresh-Water Fishes" exhibited in the Department of Zoology of the British Museum (Natural History). This edition has been revised by the original author, Dr. C. Tate Regan; it is practically a reprint of the 1917 edition with one or two very minor alterations, but the paragraph on the common eel has been rewritten to include the new knowledge gained in recent years on the life-history of this fish through the researches of the late Dr. Johannes Schmidt. This publication, which is still priced at sixpence, is an invaluable little handbook for the identification of the fresh-water fishes of Great Britain.

Amphibia and Reptiles of North China

A CONCISE and excellent "Handbook of North China Amphibia and Reptiles" by Dr. Alice M. Boring, C. C. Liu, and S. C. Chou, has been published as a Peking Natural History Bulletin (August 1932). It contains keys for the identification of the various families, and of eggs and tadpoles of the species of frogs and toads. The descriptions of the characteristic structures and habits of species, and the excellent drawings, should greatly help the natural history survey of the country, which is one of the objects of the Peking Natural History Society.

Mr. T. Sheppard and the *Naturalist*

WITH the close of 1932, Mr. T. Sheppard retired from the editorship of the *Naturalist*, having served it as editor for thirty years. As an illustrated monthly journal, designed for readers within the domain of the Yorkshire Naturalists' Union, the *Naturalist* has maintained a high standard, and in its comments and reviews it conveyed a touch of the editor's vitality and boisterousness. The occasion of his retirement was made an opportunity of presenting Mr. Sheppard with his portrait in oils by Mr. Vincent Galloway.

Kansu Earthquake of December 26

EARLIER than was expected, reports have arrived from north-west China about the earthquake of December 26 (local time). From these, it appears that 280 persons were killed and 300 seriously injured, while 800 houses were destroyed. These losses occurred in the north-west of Kansu, one of the Chinese provinces most frequently visited by disastrous earthquakes.

Announcements

DR. F. A. BATHER has been awarded the Mary Clark Thompson medal of the National Academy of Sciences, Washington, "for his distinguished services in the fields of palæontology and geology".

THE tenth annual conference of the Association of Special Libraries and Information Bureaux will be held at the Wills Hall, Bristol, on September 22-24, under the presidency of Sir Charles Sherrington. Further particulars can be obtained from the Secretary of the Association, 16, Russell Square, London, W.C.1.

AT the annual general meeting of the Association of Economic Biologists held in the Imperial College of Science, London, on February 24, the following officers for the ensuing year were elected:—*President*, Prof. W. B. Brierley; *Vice-Presidents*, Prof. J. W. Munro, Prof. W. Brown; *Hon. Treasurer*, Dr. J. Henderson Smith; *Hon. Editors*, Prof. W. B. Brierley, Prof. J. W. Munro; *Hon. Secretaries*, Prof. R. H. Stoughton, Mr. G. Fox-Wilson.

AT the ninety-first meeting of the American Association for the Advancement of Science, which was held on December 27-31, at Atlantic City, Prof. Henry Norris Russell, research professor in astronomy and director of the Observatory at Princeton University, was elected president for the ensuing year, and Prof. Henry B. Ward, who retires from the professorship of zoology in the University of Illinois in June next, was elected permanent secretary. The American Association prize of 1,000 dollars has been awarded to Dr. Henry Eyring, of Princeton University, for a paper entitled "Quantum Mechanics and Chemistry, with particular Reference to Reactions involving Conjugate Double Bonds".

THE Oxford University Press will publish in April the first number of a new *Empire Journal of Experimental Agriculture*. This journal will offer agricultural research workers in the British Empire a medium for disseminating the records and results of their investigations on the feeding and management of livestock, cultivation and manuring of crops, trials of farm machinery, agricultural economics and experimental technique. The *Journal* will command a strong editorial Board, including, among others, Sir John Russell, Sir Rowland Biffen, Sir Daniel Hall, Sir Robert Greig, Sir Frederick Keeble and leading agricultural authorities in the chief countries of the Empire. Dr. E. H. Tripp, 40 Trewsbury Road, Sydenham, London, S.E.26, is secretary and general editor. The *Journal* will be published quarterly: subscription price 20*s.* for four numbers or single numbers 7*s.* 6*d.* net, each.

APPLICATIONS are invited for the following appointments, on, or before, the dates mentioned:—A mathematics master at the Junior Technical School of the Wimbledon Technical College—The Principal (March 10). An assistant lecturer in zoology at the University of Manchester—The Registrar (March 11). A teacher in electrical engineering subjects at the Southall Technical College—H. M. Walton, Education Offices (H), 10, Great George Street, London, S.W.1 (March 21). A woman tutor in hygiene and biology at the Edge Hill Training College, Ormskirk, Liverpool—The Principal (March 24). A director of the Royal Technical College, Glasgow, and a professor of technical chemistry at the College—The Secretary (April 17). Physicists and electrical engineers for the staff of the Radio Research Board of the Commonwealth of Australia Council for Scientific Research—F. L. McDougall, Australia House, Strand, W.C.2.

ERRATUM.—NATURE, February 25, p. 268, col. 2, paragraph entitled "Fat in Æstivating Animals", line 13 for *Pachyurus* read *Pachyuromys*.

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Reviews

Pliny's Chemical Knowledge

The Elder Pliny's Chapters on Chemical Subjects. Part 2. Edited, with Translation and Notes, by Dr. Kenneth C. Bailey. Pp. 299. (London: Edward Arnold and Co., 1932.) 15*s.* net.

"IT occurs to one to marvel at the persistent experimenting of humanity," said Pliny, "which has exempted neither dregs nor foulest residues from the most varied examination." It did not occur to him—vain though he was—to marvel equally at his own persistent accumulation of the most varied scraps and orts of knowledge. What a contributor, through accident of time, was lost to "Notes and Queries"! So vast is the extent of the "Natural History" that few men, in these rapid days, can have read the whole work; and so heterogeneous is it that probably few men would care to do so. Yet to the historian of chemistry, Pliny must be of paramount importance as a source-book of Roman chemical knowledge, not only because his mass of information is so great, but also because there are so few other sources of any kind. It is therefore with peculiar pleasure and satisfaction that we welcome the second and concluding part of Dr. Kenneth Bailey's book, in which all the important chemical passages not contained in the first part are collected, translated, and very adequately annotated.

Among the interesting facts that Pliny describes is the manufacture of cadmia or zinc oxide by roasting zinc ores. "It is made", he says, "when the most subtle portion of the charge is expelled by the fiery blast and deposited either in the roof-chambers or on the furnace-walls, in accordance with its density." As in modern practice, the product was graded by density and the distance to which the fumes were carried, the best quality occurring inside the furnace itself, where it hung from the arches of the roof-chamber. Ores containing zinc were well known to the Romans, and it appears probable that the alloy which we call brass was indeed a Roman discovery. Dr. Bailey observes that Roman copper coins from Augustus to Gallienus regularly contained zinc, and that brasses discovered at Silchester are practically identical in composition with Tournay's alloy (copper, 82·5; zinc, 17·5), used extensively for the imitation of gold.

Upon lead, Pliny remarks that it "is mined with great toil in Spain and in all the divisions of Gaul, but occurs in Britain in the surface stratum of the ground, and in such abundance that the amount refined is actually limited by law". It is a little surprising that in his note on this passage, Dr. Bailey, though mentioning the occurrence of lead in Cornwall, Derbyshire, Cumberland and Shropshire, does not refer to the extensive Roman lead mines on the Mendips—those *montes minerarii, plumbi admodum fertiles*—where the largest pig of Roman lead ever found in Britain was discovered at Charterhouse-on-Mendip in September 1873. Possibly his attention was momentarily distracted by the delightful application of lead described a few lines further on: "Nero, by the will of the gods Emperor, used to sing solos with a sheet of lead over his chest, and thus demonstrated a method for maintaining the voice"!

Verdigris, used in salves and for other medicinal purposes, was manufactured in various ways, such as sprinkling vinegar on copper filings and stirring the mixture several times a day with a spatula until the reaction was complete. The product, especially that exported from Rhodes, was frequently adulterated with powdered marble, pumice or gum, but more particularly with shoemakers' black (ferrous sulphate). Pliny says, quite rightly, that the presence of the last adulterant may be detected by means of a piece of paper steeped in extract of gall-nuts, which is immediately blackened by verdigris containing *atramentum sutorium*. Such versatility in experiment as is implied by qualitative tests of this recondite nature renders all the more incomprehensible the later fortunes of chemistry, with its 'artificial' gold and silver almost universally accepted as genuine.

Among the properties of blue or green vitriol Pliny mentions its use to cure deafness, to expel intestinal parasites, to relieve pains in the eyes, and to cleanse ulcerous excrescences. But it is plain that he likes best of all the "recent discovery for use in the arena", namely, that if vitriol is thrown into the faces of bears or lions, it exercises so powerful an astringent effect as to prevent them from biting.

The prevention of the rusting of iron, though not so urgent a problem for the Romans as for the modern world, had received attention. Pliny complacently remarks that, as iron inflicts most loss on short-lived humanity, a benevolent nature showed laudable foresight in exacting from it the penalty that it needs must rust; but he goes on to say that it may be protected against rust by white lead, gypsum, or pitch. He also relates the story (without lending it his support) that rusting may be prevented by a suitable religious ceremony, and mentions that an iron chain was still in existence, at Zeugma on the Euphrates, which was used by Alexander the Great in bridging the river there. "Those links which have been renewed are a prey to rust, from which the original links are quite free." The iron pillar at Delhi is an indication that the production of rustless iron is perhaps not altogether a modern achievement, and the story of Alexander's chain may possibly have some foundation in fact.

It would be easy to lengthen considerably this selection of extracts from Pliny's engaging story, for no page is without its interest and its problem. The interest is Pliny's own, who in the end discovered more about sulphur dioxide than its bleaching and germicidal powers; but the solution of most of the problems is due to Dr. Bailey, whom we may once again thank for his careful and ingenious labour. E. J. HOLMYARD.

Comenius in England

Comenius in England: the Visit of Jan Amos Komenský (Comenius), the Czech Philosopher and Educationist, to London in 1641–1642; its Bearing on the Origins of the Royal Society, on the Development of the Encyclopædia, and on Plans for the Higher Education of the Indians of New England and Virginia, as described in Contemporary Documents. Selected, translated and edited, with an Introduction, and Tables of Dates, by Robert Fitzgibbon Young. Pp. vii + 99 + 12 plates. (London: Oxford University Press, 1932.) 10*s.* net.

JAN AMOS KOMENSKÝ, the famous Czech philosopher and educationist, better known by his Latinised name, Comenius, was born at Uherský Brod, Moravia, in 1592. He spent a few years at the University of Herborn, in Germany, under Alsted, whose encyclopædic ideas he was later to develop. Comenius returned to teach for a time in Moravia, but his promising career was interrupted by the Thirty Years' War which began in 1619. As one of the Bohemian Protestants, Comenius went into exile in 1628 and settled at Leszno in Poland, where he taught at the college of the *Unitas Fratrum* and wrote some of his remarkable Latin and vernacular educational works which are still of interest to-day.

Always hoping to be allowed to return to his native land, Comenius made many journeys across Europe. Everywhere he impressed men of learning by his teaching abilities, his writings and by his pansophic plans. He conceived the idea of erecting an international college or academy of sciences where every branch of human knowledge would be studied and made available in encyclopædic form. Such a 'universal college' was to be a "living laboratory supplying sap, vitality and strength to all".

At this time great developments in mathematics, physics and biology were taking place in England and elsewhere as an aftermath of the humanistic Renaissance of the fifteenth century. Comenius's all-embracing schemes appealed to contemporary scholars and through Samuel Hartlib, a native of Elbing in East Prussia, they were made known in England.

In 1641 a group of members of both Houses of Parliament invited Comenius to England. He arrived on September 21, 1641, and remained until June, 1642. The exact influence of Comenius upon his English contemporaries is difficult to ascertain and for this purpose Mr. R. Fitzgibbon Young has collected in his valuable monograph the relevant documents (ten in all) describing Comenius's plans for a Baconian college and other details of his visit to London. From these carefully annotated documents it is clear that many influential scholars (including several who were later prominent fellows of the Royal Society) and public men were favourably impressed by these plans.

Unfortunately, more urgent matters absorbed the attention of Parliament and the plan for a universal college was abandoned. Only after the Restoration in 1660 was it possible to make use of some of Comenius's ideas when the Royal Society was incorporated in 1662. As outlined in his "Via Lucis", which was written whilst he was in England, Comenius intended his college or society to serve as a meeting-ground and intellectual clearing-house for men of science from all over the world and it is interesting to note that, from its inception, the Royal Society had a certain international character through its foreign members and correspondents.

There is no doubt that Comenius was deeply disappointed when he found that his plans could not be realised in England. His subsequent efforts in Sweden and Holland were no more successful, but he rejoiced later when the Royal Society was founded and he dedicated his "Via Lucis" to it in 1668.

Mr. Young has also discovered interesting evidence which seems to indicate that whilst in England, Comenius was approached by John Winthrop, Governor of Connecticut, with the view of visiting America and establishing a college for educating the Indians of New England, but this also did not materialise.

Mr. Young has included tables of dates of events in the life of Comenius and illustrating the development of scientific societies. He throws fresh light upon the origins of the Royal Society and the general development of plans for scientific societies and for the compilation of encyclopædias in the seventeenth century. He is the first to point out that Comenius's ideas found fruition in the writings of G. W. Liebniz, who, with Comenius's grandson, Bishop D. E. Jablonski, was the principal founder of the Berlin Academy of Sciences in 1700. J. G. F. D.

Sir Bertram Windle

Sir Bertram Windle, Bertram Coghill Alan Windle, F.R.S., F.S.A., K.S.G., M.D., M.A., LL.D., Ph.D., Sc.D.: a Memoir. By Dr. Monica Taylor. Pp. xiii + 428 + 4 plates. (London: Longmans, Green and Co., Ltd., 1932.) 12*s.* 6*d.* net.

BY a stroke of good fortune it has been possible to secure for the writing of this memoir the services of one who—a distinguished pupil of Prof. Graham Kerr—shared both the scientific interests and spiritual emotions of her subject. Those who knew how deep his religious sense, how strong his liturgical leaning, will appreciate how incomplete would be any memoir of Windle in which this side of his personality was not adequately represented. Another cause for congratulation is that not merely has the task been entrusted to sympathetic hands, to the hands of one who shared his technical knowledge of that branch of biology, cytology, which particularly interested him, but also to the hands of one who obviously possesses rare literary ability, the result being that we are given a complete, intimate and vivid portrait of a very remarkable man.

No one who ever entered Windle's presence could fail to realise that he was an outstanding personality, an impression which, if we can analyse such things, was largely due to the sense of energy and power which he conveyed: the charm of his personality, great and irresistible, was only clearly disclosed to his friends and only fully to them in his rare moments of ease and relaxation.

His life naturally falls into three periods, spent in centres so apart as Birmingham, Cork and Toronto. It was in Birmingham that his scientific investigations began and ended, for already before he left that city his energies were being more and more employed in general educational work—the foundation of the University (the first civic university in England), the organisation of its faculty of medicine, the chairmanship of the Education Committee of the General Medical Council, the performance of almost innumerable offices in connexion with general education in the Midlands. Had he continued his scientific investigations, they would in all probability have been along the lines of experimental embryology, a subject of unfailing interest to him and one to which he had been led by his studies in teratology —for many years he contributed an annual summary of the literature on this subject to the *Journal of Anatomy*—and in cytology, studies which made him an early member of the vitalistic school.

In Cork, where he went as president of Queen's College, Windle found ample scope for his energy and ability in the re-organisation of the College—adding to its buildings, dividing up its departments, enlarging its staff, improving residential accommodation for its students and taking an active general interest in the welfare of its staff and students. He was particularly successful in securing increased grants and generous benefactions, with the result that the College rapidly rose in status. Although he never achieved his ambition of converting the College into a university—the University of Munster—he was largely instrumental in its becoming one of the three university colleges in the National University of Ireland. As in Birmingham, his interest in education was far from being confined to the institution with which he was officially connected. He became a well-recognised figure on the platform, often in the chair at meetings throughout the country and was one of those nominated by the Prime Minister as a member of the Irish Convention of 1917.

At the close of the War, the dismal rôle for which Ireland above all countries seems to be cast, that of 'stoning the prophets', in other words, driving into exile those most willing and best fitted to serve her, came again to be played. The strange and violent opposition of Sinn Fein to Windle's project of a university for Munster, the project which had been close to his heart ever since his first landing in the country and to which the major part of his energies had been persistently bent, made his resignation inevitable and irrevocable.

The last period of Windle's eventful history was spent in Toronto where, far now from Ephesus, he spent the evening of his life in the quiet air of congenial studies, writing and lecturing on many subjects, some as diverse as Roman Britain, Thomas Hardy, science and religion. As always, he played an important part in the life of the city, being particularly prominent in connexion with university institutions and medical charities.

Such in barest outline is the record of a life and career of ceaseless activity and high distinction, a record which Dr. Taylor, assisted by an unusually large number of intimate letters, but yet with consummate knowledge and skill, has been able to convert into a narrative of absorbing interest, placing incidentally the many friends of Windle under a debt of deepest gratitude.

William Wright.

Georgia and its People

A History of the Georgian People: from the Beginning down to the Russian Conquest in the Nineteenth Century. By W. E. D. Allen. Pp. xxiv+429+31 plates. (London: Kegan Paul and Co., Ltd., 1932.) 31*s*. 6*d*. net.

IN a laudatory introduction to this book, Sir Denison Ross emphasises the scant attention Georgia has received latterly from historians and other scholars. Since the publication of Brosset's "L'Histoire de la Géorgie", three quarters of a century ago, nearly everything that has been written relating to the people and the country has appeared in either Russian or Georgian. For this, no doubt, its troubled history in the earlier half of the last century is responsible; but it is surprising that a country, of which the beauty and charm has been celebrated by more than one Russian writer well known to the western world, should have been thus neglected in later years.

Mr. Allen's "History of the Georgian People" covers a long range of time. He begins with the bronze age and ends with the beginning of the nineteenth century, when the Georgian kingdom fell before Russia, although the country was not completely subdued until many years later. Mr. Allen does not write as an archæological expert. His account of the prehistoric period is a summary of the views generally accepted by archæologists at the moment, but it is none the less to be appreciated on that account. He marks how little is known with certainty and how great a field for exploration is offered in this little-known area, which not only includes the ancient Colchis, but was also evidently in more or less close touch with the Hittites and, probably, with other early empires of the Middle East. The archæology and ethnology of a people speaking a language with no proved affinities clamour for intensive study.

An enormous mass of information in Russian and Georgian, mostly from the periodical literature of learned societies, has been digested in the preparation of this history. The story of the medieval Georgian kingdoms is virtually a new chapter in history, which in its account of the relations of the Georgian monarchs to Mongol, Turk and Persian is of interest not merely as it affects the Caucasus, but also for the sidelights it throws on the history of the various peoples and rulers with whom the Georgians were in contact. It is instructive, for example, to see how the tolerant rule of the early Mongol conquerors actually functioned from the point of view of the conquered country.

In addition to the historical sequence of events, Mr. Allen deals with the development of the social and economic organisation of medieval Georgia and its religion, literature and art. Each of the chapters on these subjects is valuable, but the account of the social organisation, tracing its growth from the primitive congeries of family groups at about the beginning of the Christian era to the feudalised kingdom, is a field untouched by, and indeed unknown to, European sociologists. The picture of manners and customs places in a true perspective the somewhat coloured accounts of de Chardin, Tournefort and other travellers of the late sixteenth and early seventeenth centuries.

Mr. Allen has added considerably to the interest of his narrative by his illustrations, some of which show striking examples of Georgian art, while others are portraits and sketches which illustrate arms and dress at different periods from contemporary Georgian sources.

British County Flora

The Comital Flora of the British Isles (Flora Comitalis Britannicæ: Fl. Com. Brit.): being the Distribution of British (including a number of Non-Indigenous) Plants throughout the 152 Vice-Counties of Great Britain, Ireland and the Channel Islands, with the Place of Growth, Elevation, World-Distribution, Grade, Chief Synonyms and First Names by which the Plants were recorded as British. By Dr. George Claridge Druce. With an original coloured Map showing the Botanical Vice-Counties presented by William James Patey. Pp. xxxii + 407. (Arbroath: T. Buncle and Co., 1932.) 20*s*.

In his introduction, Dr. Druce gives an account of the work of Hewett Cottrell Watson, who devoted many years of a long life to the study of the geographical distribution of our British plants. Watson divided the country into provinces, sub-provinces and counties or vice-counties (112 in number) and also employed terms to indicate altitudinal distribution and the nature of the habitat. His results were collected in two classic works, the "Cybele Britannica" in four volumes (1847-59) with a "Supplement" (1860) and the "Topographical Botany" in two parts (1873-74). A second edition of the last-named was prepared by J. G. Baker and the Rev. W. W. Newbould and two "Supplements" have since been published in the *Journal of Botany*, the first by Arthur Bennett (1905), the second by Bennett, C. E. Salmon and J. R. Matthews (1929-30). Dr. R. L. Praeger's "Irish Topographical Botany" (1901), with "Supplements" in 1906 and 1929, is authoritative for the Irish counties.

These works together with "Floras of the Channel Islands" by Lester-Garland and Marquand form the basis of the "Comital Flora" in which Dr. Druce essayed to collect in one volume all available information. The plan of the work is as follows: the scientific and popular names of the plant are followed by its more important synonyms; the natural habitat, altitudinal and horizontal distribution according to Watson's vice-counties, are given, and finally the first record of the species as British based mainly on W. A. Clarke's "First Records of British Flowering Plants".

The volume, appearing so shortly after the author's death, is a memorial of his industry and his devotion to the study of our British flora; and is valuable as bringing together much scattered information. Its defects are traceable to the personality of the author, and perhaps also to hasty production, excusable in a man who has completed his four-score years. Dr. Druce was unwilling to merge his own opinions in the compromise involved in the acceptance of generally agreed rules of nomenclature, and the student will find in the pages of the "Flora" familiar plants under unfamiliar names, such as *Dondia* for *Suæda*, *Juncoides* for *Luzula*, and *Savastana* for *Hierochloe*; and whereas botanists in council have 'barred' tautonyms, Dr. Druce uses such combinations as *Meum Meum* Druce. A more serious fault is the failure to deal more fully with large and critical genera where the information was ready to hand—as in the case of *Rubus* in the work of Moyle Rogers and of more recent botanists, and *Euphrasia*, the British species of which have been treated in detail by Rigsley. The notes on the general geographical distribution of the species are sometimes incomplete—*Najas flexilis*, for example, is cited as European but occurs also in North America—or even inaccurate; and errors in the records of vice-county distribution are noticeable.

The book is neatly bound and of convenient size for a hand-book; the typography is well arranged and clear; and a large, coloured map indicating the vice-counties in Great Britain and Ireland, included as a folder, is a useful addition.

A. B. R.

Experiments on Memory

Remembering: a Study in Experimental and Social Psychology. By Prof. F. C. Bartlett. (The Cambridge Psychological Library.) Pp. x + 317 + 3 plates. (Cambridge: At the University Press, 1932.) 16*s*. net.

PROF. BARTLETT'S experimental investigation of remembering is to be welcomed as a valuable scientific investigation which, in many ways, breaks new ground. During the years since Ebbinghaus invented the experimental method which makes use of nonsense syllables, it is probable that as much has been discovered by this method as ever will be. On the whole, the results have been disappointing.

With the passing of interest in the laws of association, which are now recognised to be merely the laws of thought habit formation and not the fundamental laws of effective thinking, new ways of study have become necessary. Prof. Bartlett has used a method in which folk-lore stories, news stories, drawings, or other items of meaningful material are successively reproduced by a single person or are handed on from person to person. Particularly interesting are the results of the latter kind of experiment, which demonstrate the process of social conventionalisation by which folk stories may be supposed to have been formed and by which originally representational drawings may have been conventionalised into the letters of the alphabet.

The present stage of development of experimental psychology is undoubtedly one in which the widest possible variety of methods is to be encouraged since no one knows which will be most fruitful. It is a pity that Prof. Bartlett allows himself to attack the use of statistical methods, which provide one of the most promising methods of approach. He complains that statistical methods are scientific makeshifts because they are only used on data in which disturbing causes prevent the appearance of invariable relationships. This, however, is really an argument for excluding all quantitative problems in which relationships are not invariable (that is, those in which there is merely a 'tendency' for an effect to appear in certain conditions) and is not an argument for admitting tendencies to relationship without adequate consideration of the problems of chances of sampling. Prof. Bartlett himself refers to many tendencies which arise out of his work. Thus, on p. 61 it is stated that visualisation 'tends' to lead to confusion as to order of presentation and 'favours' the introduction of extraneous material, while vocalisation 'favours' a certain kind of classification and 'tends' to set up an attitude of uncertainty.

Prof. Bartlett is a careful and self-critical investigator and it is most likely that he has adequate evidence for these tendencies, but he does not give the figures which alone can enable us to determine the likelihood that these are not spurious tendencies produced by the chances of sampling. The truth is that in many biological inquiries, and particularly in psychological ones, the choice is not between invariable relationships and tendencies. The most carefully controlled conditions will not make the observed relationships invariable. The choice is between inadequate treatment of observed tendencies and their adequate treatment by the use of statistical methods.

Prof. Bartlett's theoretical chapters on the theory of remembering, on the functions of images and on meaning are a valuable contribution to the subject. He rejects the over-simple 'memory-trace' hypothesis, still too popular amongst the teachers of allied sciences, and bases his own view on Head's theory of 'schemata'. He describes remembering as "an imaginative reconstruction, or construction, built out of the relation of our attitude towards a whole active mass of organised past reactions or experience, and to a little outstanding detail which commonly appears in image or in language form" (p. 213). R. H. T.

The Process of Metamorphism in Rocks

Metamorphism: a Study of the Transformations of Rock-Masses. By Dr. Alfred Harker. Pp. x + 360. (London: Methuen and Co., Ltd., 1932.) 17*s.* 6*d.* net.

A RICH store of observations especially on the metamorphic rocks of Great Britain, numerous excellent drawings of rock sections as seen in the microscope and admirable clarity of statement are the outstanding features of this new book on metamorphism. In the first part, which is devoted to thermal metamorphism, general genetic considerations occupy about one-third of the space and are followed by a detailed account of the thermal metamorphism of argillaceous, calcareous and siliceous sediments and of igneous rocks. Especially in connexion with the last named, much interesting information is given. The second part treats in similar fashion of dynamic and regional metamorphism with very brief chapters devoted to injection, repeated and retrograde metamorphism.

Throughout the book the reader is left with the impression that the author's knowledge of metamorphism is based on the rocks of Great Britain and is struck by the fact that a discussion of the conditions prevailing in the oldest formations as in the youngest, for example, the fold-system of the Alps, is largely wanting. In these circumstances the systematic and most important parts of the book offer an interesting counterpart to publications dealing especially with archæan and alpine metamorphism. But it is no less true that the limitations thus indicated, to which must be added the fact that a lack of references to the non-English literature of the past twenty years is very noticeable, constitute a real shortcoming in the work as a whole. It is greatly to be feared that this book with all its obvious advantages (should it come to be used in Great Britain as a compendium of contemporary knowledge on metamorphism) will tend by what it omits to delay the adaptation of many results of modern research to the further study of British metamorphics. A divergence between the Continental and British schools of metamorphism might thus arise, which could only be of mutual disadvantage.

Dr. Harker stresses the point that his text is equally allotted between thermal and dynamic metamorphism and that he is more concerned with the processes than with the results of metamorphism. In these respects he believes his point of view to be in contrast to that of what he calls the "German School" but which more correctly should be termed the Austrio-Swiss or Alpine School after its most eminent representatives, F. Becke and U. Grubenmann. This assumption, which is the starting point of the book, is in two respects erroneous. For, on one hand, it has apparently escaped the author's notice that a third edition of Part I of Grubenmann's book "Die kristallinen Schiefer" appeared in 1924 under the title "Die Gesteinsmetamorphose" and treats practically only of the processes of metamorphism. Thermal and dynamic metamorphism are discussed separately and full account is taken of the general physico-chemical principles governing these processes. If, secondly, Grubenmann in his systematic part was mainly concerned with the products of metamorphism, it must not be taken to mean that he (or Becke) was indifferent to the processes as such. It was, however, necessary to clear up the question of terminology, to bring out the importance of the chemical composition of the original rocks and to find a basis on which to discuss polymetamorphic rocks or such, about the mode of metamorphism of which nothing precise is known. Dr. Harker has, of course, to deal with all these questions, too, but no progress is achieved when vague terms such as "argillaceous sediments", "basic igneous rocks", etc., are used instead of the preciser information given by the chemical classification in the older book.

It must be considered a serious omission in the book that no mention is made of the question of *Gefügeregelung*, of the methods used in its investigation or of its dependence on tectonics. The names of the Austrians, Sander and Schmidt, who in the past twenty years have done work of the greatest importance and have recently published books, are not even mentioned. Very many phenomena connected with pneumatolysis, injection, assimilation and palingenesis are left untouched, so that the impression gained from Dr. Harker's treatment is quite inadequate as regards the complexity of these processes.

It is obvious that the various points mentioned in no wise lessen the value of what Dr. Harker has written, so long as the reader is aware of the limitations in the treatment. For the alpine petrographer, for example, much of the information, based as it is on accurate observation, will be of the greatest interest. At the same time, it is to be hoped that a book which may be described as the most important contemporary English work on metamorphism, will not obscure the existence of some wider issues in metamorphic petrography which are of very real importance to the subject as a whole. P. NIGGLI.

Early History of the British Coal Industry

The Rise of the British Coal Industry. By Prof. J. U. Nef. In 2 Vols. (London School of Economics and Political Science (University of London): Studies in Economic and Social History.) Vol. 1. Pp. xiv+448+14 plates. Vol. 2. Pp. vii+490. (London: George Routledge and Sons, Ltd., 1932.) 42*s*. net.

THE above work is in many respects a very remarkable one. First of all it is sufficiently curious that a professor in the heart of the United States, in Chicago, which is not even a coal-mining centre, should concern himself with a study of the coal industry of Great Britain. The material which the author has made use of is also very remarkable both for the extent of the resources of which he has availed himself and of those which he has overlooked. He himself admits in his preface that he has not made as much use as he might have done of the important work by Messrs. Ashton and Syke, "Coal Industry of the Eighteenth Century"; he appears to have entirely overlooked that valuable compilation "Historical Review of Coal Mining", published by the Mining Association of Great Britain in 1925 in connexion with the Wembley Exhibition, and he has not made any really effective use of the very valuable collection of manuscripts and other documents in the possession of the North of England Institute of Mining and Mechanical Engineers.

Had his researches been somewhat more extended, Prof. Nef would probably not have taken the same limits to his work as he has done, because he puts down the growth of the British coal industry as having taken place between the dates 1550 and 1700, basing his arguments upon the following statistics: he states that the vend from the Newcastle coalfield in 1564 was a little less than 33,000 tons, whilst in the year 1700 it was 650,000 tons, and in 1864 it was approximately 18,350,000 tons. He shows that the rate of multiplication in the first period was very much greater than in the latter periods. But surely the rate of multiplication is not the correct basis for an estimate of this kind, which should be rather the rate of addition than the rate of multiplication. It is quite true that in the year 1550 very little coal was consumed, and in the year 1700 there was a much greater consumption of coal, owing no doubt to the increasing scarcity of wood, which caused coal to come into fairly extensive use for domestic purposes. No doubt the increase in domestic consumption had something to do with the fact that at the earlier date most of the coal available would be outcrop coal, which, as is well known, is very much dirtier than coal obtained from greater depths in the seam, where surface effects have probably disappeared.

Of course, by selecting arbitrarily the year 1700 as the end of his investigation, Prof. Nef has missed entirely the great main reason for the expanse of the British coal industry, namely, the use of coal for the generation of power and for the smelting of iron, which came in, as is well known, towards the end of the eighteenth century. Furthermore, it was towards the end of the eighteenth century that the power-loom was invented, which would have been practically useless without the steam engine to drive it or iron made by the use of coal to construct the machinery. Then again, even at the beginning of the nineteenth century means of transport were exceedingly bad; the first railway (another utilisation of steam and therefore of coal) was not opened until 1822, and even at the beginning of that century roads were few and extremely bad.

It may fairly be claimed that whatever developments future ages may have in store, there will probably be none of such far-reaching importance as the application of the latent energy of coal to the generation of power. Until that date the only energy made use of by mankind had been kinetic (that is, visible) energy; even potential energy, such, for example, as that of water at a high level, was not really used until the water was in motion and made to turn a wheel, so that even in this case it may fairly be said that kinetic energy was the source of power. Possibly at some future date we shall learn to make use of atomic energy, but even such a discovery would be less epoch-making than the discovery that latent (that is, invisible) energy could be pressed into the service of mankind.

The fact that both the use of coal for the production of power and the use of coal for the production of iron were British inventions necessarily contributed enormously to the development of the British coal industry. Again, Murdoch's discovery of coal gas was not made until the very close of the eighteenth century, or a century after Prof. Nef has thought fit to close his review of the rise of British coal mining, yet to-day more than ten per cent of the coal produced in Great Britain is gasified, whilst the consumption of coal for iron-making averages something like eight per cent.

Prof. Nef seems to have overlooked the fact that for many centuries Great Britain was the world's leading producer of coal; indeed it was not until the year 1899 that the British output—obtained from this one small island—was exceeded by the output from the United States with its vast territory. In fact, the coal trade of Great Britain continued on a steady increase until well into the twentieth century; the output of British coal for 1913 (the year before the War) was not less than 287·43 millions of tons, of which more than one-third was exported. Even to-day when the output has necessarily fallen off considerably, for reasons which are perfectly well known but need not be discussed here, Great Britain is producing more than seventeen per cent of the world's coal, whilst according to the latest statistics, its coal resources are barely 2½ per cent of those of the whole world. In other words, Great Britain is producing something like seven times as much coal as its known resources should entitle it to do, and even if we admit that the zenith of the British coal industry has been passed, we are still, in comparison to our resources, by far the world's greatest coal producers.

Although, therefore, one cannot possibly agree with Prof. Nef as to the limits within which he has attempted to restrict the rise of the British coal industry, seeing that the maximum output of British coal was probably about ten times as great as it was in the year which he has selected for the close of his survey, one is bound to admire the industry which he has shown in compiling the great mass of facts, some of them by no means easy of access, which relate to the period to which he has chosen to confine his attention. We may perhaps express the hope that at some not too distant date he will complete his history up to, say, the commencement of the War, which probably marks the zenith of British coal production.

Evolution of Hydrodynamics

Hydrodynamics. By Sir Horace Lamb. Sixth edition. Pp. xv+738. (Cambridge: At the University Press, 1932.) 45*s.* net.

THE development of a book through successive editions is very like the evolution of a species. It has to adapt itself to changed circumstances by the insertion of new material; portions cease to be of explicit use, sometimes through the acquirement of new methods that do the work better, sometimes because their applications cease to exist. For economic reasons the book will survive better the more thoroughly the new adaptations are carried out and the superfluous parts eliminated. Nevertheless vestigial traces remain.

In such a work as Lamb's "Hydrodynamics", first published in 1879, these processes are well exemplified. It may perhaps be thought that the whole plan of the book is obsolete and that complete rearrangement is necessary. For the first 561 pages it considers only the classical fluid, in which the internal reaction across an element of surface is always normal to the element, and which can slip freely over solid boundaries. The next chapter considers for the first time the real or viscous fluid; and there is a return to classical fluids in the last. Perhaps this is inevitable; the equations of viscous motion are not things one would like to meet at the very introduction to a subject. Further, though classical hydrodynamics is scarcely ever in exact agreement with the facts, it is often an excellent approximation; for example, the whole of the chapters on tidal waves, surface waves, and waves of expansion are still valid in a viscous fluid.

Still, seeing that the fundamental postulates of classical hydrodynamics are wrong, there is a definite problem in explaining why its results are ever right. The attention given to this question is somewhat casual. On p. 106 the inability of a fluid to turn round a projecting corner is attributed to the formation of a negative pressure, instead of to the fact that this is the most striking case where classical results do not give any approximation to the behaviour of a real fluid. The proposition that vorticity in a real fluid cannot originate in the interior, but must be diffused inwards from the boundary, is given in small type on p. 578; I should prefer to state the result in the form of a modification of the circulation theorem, but even in the form given to it by Lamb it could have been made the basis of an explanation of why so much of the earlier part of the book has physical value. Again, much attention is given to vortex motion in Chap. vii; but we might have expected to find somewhere an explanation of how isolated vortices come to exist. Many results are given that have a bearing on these questions, but they are not co-ordinated in such a way as to bring out their fundamental importance.

The process of adaptation to modern conditions has, however, been successful in other matters. The lift of a Joukowsky aerofoil is determined on p. 82; the formula for the resistance due to a Kármán street is quoted; the theory of the effect of viscosity on sound waves is extended. But the most striking additions are the inclusion of an account of the boundary layer theory and one of the effect of compressibility on the motion of fluids around solids, both of which topics are becoming extremely important in aeronautics.

The account of Reynolds's theory of the stability of laminar motion survives; this is remarkable, since Reynolds's discussion proves nothing at all. Orr showed that above a certain Reynolds number some of the types of disturbance, starting small, increase to a maximum, and then die down again. According to Reynolds's method, which considers only the early behaviour arising from a given initial disturbance, these would imply instability; but Orr's discussion of their later behaviour shows that they do not. On the other hand, where Reynolds fails to find his disturbance increasing, stability is not proved, for instability might occur for a different type of initial disturbance.

There is a curious minor vestige on p. 17, where it is stated that the reason for the introduction of the minus sign in the definition of the velocity potential is given in the preface: but the preface that gave it has disappeared in the process of revision. Another is the slip of the pen, $-\omega^2 z$ for 0 on p. 697.

Nevertheless, if we carry our biological analogy a little further, we may predict that the new edition will succeed and probably lead to further successful adaptations. Where a species has material for its existence, even if its adaptation to its conditions is not perfect, it will survive until a better adapted species enters into competition with it; and a book on hydrodynamics capable of competing with Lamb's is unlikely to be produced for some considerable time.

HAROLD JEFFREYS.

Chemistry and our Idiosyncrasies

The Inborn Factors in Disease: an Essay. By Sir Archibald E. Garrod. Pp. 160. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 7*s.* 6*d.* net.

EVERY one of us is characterised by more or less marked personality as an individual, in addition to belonging to a particular race and having its special attributes. It is permissible to assume that we possess chemical individuality also, that each one of us, varying perhaps on either side of a chemical mean, is built up of slightly different materials from his fellows and leads his own chemical life.

Sir Archibald Garrod, whose well-known book on the inborn errors of metabolism has for many years stimulated thought on this subject, has in his new essay, which had its origin in a Huxley lecture delivered at Charing Cross Hospital, still further broadened the outlook. Bodily metabolism is definitely chemical; our idiosyncrasies, the inborn factors which are apparent in disease, are all intimately connected with the chemical life of their subjects and the chemical structure of their tissues. Since man springs from the chromosomes of the germinal cells, the starting point of the mutations must lie in their variation, and it is difficult to escape the conclusion that upon the chemical structure of the chromosomes depend the structure and form of the creatures which originate from them.

The influences of natural selection which are always at work ensure the survival of helpful mutations and the destruction of those that are detrimental. It is to be supposed that just as, normally, the same chemical reaction is repeated when the same reagents come together under suitable conditions, so it is possible when the conditions are ever so slightly varied for side reactions to occur in greater or less degree. The laboratory experience with catalytic agents, particularly those of an organic nature like the enzymes, affords ample evidence of this variable secondary change, and it is, therefore, not difficult to see how mutations can arise which are in no way restricted to members of a single family or race.

The normal man is one who does not depart in any conspicuous respect from the average of the race: some deviate from the normal to their benefit, others to their detriment. It is highly probable that chemical defects, or errors of metabolism, are common but they escape detection because but few of us, and then only occasionally, are subject to clinical and chemical examination. Our idiosyncrasies, which often affect health out of all proportion to the external causes which provoke them, are undoubtedly due to the disturbances caused by the intrusion of a foreign chemical substance, most often probably of a protein nature. Some of us are hypersensitive to eggs, others to shell-fish, others to strawberries, a few are sensitive to pollen and suffer from hay fever: there is much evidence that all these are inborn and hereditary peculiarities. In such idiosyncrasies it is to be supposed that the poison acts as an antigen reacting with an antibody in the cells of the subject, with the result that histamine is liberated from the damaged cells. What is inherited is an undue liability to such cellular protests.

Metabolism in the body is brought about by ferments activated apparently by specific chemical messengers set free from the ductless glands. Such ferments may be pictured as normally engaged in regular daily work, but they are available, particularly those in the liver, to deal from time to time with unusual substances as best they can. Some day we shall isolate and synthesise the antitoxins just as we have begun to do with the hormones, adrenalin and thyroxin.

We may ask the question: Is the human body a mere machine governed wholly by the principles of physics and chemistry? Whenever it is understood, the answer is in the affirmative, and such work as that of Pavlov has extended our positive knowledge into the field of the control of the nervous reflexes. The growth of science has largely swept away the beliefs of the traditionalist, but vital principles may still lurk in processes not completely understood.

E. F. ARMSTRONG.

Short Reviews

Anthropology and Archæology

Israel: from its Beginnings to the Middle of the Eighth Century. By Prof. Adolphe Lods. Translated by Prof. S. H. Hooke. (The History of Civilization Series.) Pp. xxiv + 512 + 16 plates. (London: Kegan Paul and Co., Ltd., 1932.) 25*s*. net.

"The unique importance of the people of Israel," says M. Lods, "is due to its religion"; but he adds that the study of the origin and development of that religion depends upon the success of a number of preliminary or subsidiary investigations. He therefore surveys the archæology, history and social, cultural and religious development of Palestine under three main heads: first, of the people who inhabited the area before the settlement of the Hebrews; secondly, of the Hebrews themselves before they entered it; and thirdly of the Hebrews after the settlement, when the two streams of cultures had coalesced to produce the characteristic Hebraic system prior to the middle of the eighth century before our era.

It will be obvious that if the field covered by Mr. Lods is one to which the greatest interest is attached owing to its influence in the development of the modern cultures of Christianity and Islam, it is also one into which conjecture enters largely. Upon the major controversial issues such as the ethnic character of the early inhabitants of Palestine and their relations with the Hebrews, the sojourn in Egypt and the Exodus therefrom, M. Lods displays a wise conservatism. He has not allowed himself to be led away by recent tendencies to regard every archæological discovery as a confirmation of the Bible text. The facts are placed before the reader and discussed thoroughly and dispassionately. For this, but not for this alone, M. Lods's book must be accounted a valuable addition to the already extensive literature of the subject.

(1) *Social Anthropology.* By Dr. Paul Radin. (McGraw-Hill Publications in Sociology.) Pp. xii + 432. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 21*s*. net.

(2) *Economics in Primitive Communities.* By Prof. Richard Thurnwald. (Published for the International Institute of African Languages and Cultures.) Pp. xiv + 314. (London: Oxford University Press, 1932.) 25*s*. net.

(1) The aim of Dr. Radin's textbook of social anthropology is to emphasise man's positive achievement in social organisation and to avoid the undue stress hitherto laid on magic and the irrational side of primitive man's life. He has also avoided general theoretical discussion except in an introductory chapter in which he submits ethnological theories to a very fair and unbiased critical examination. His method has been to set himself a number of specific tasks in description such as the organisation of the State, the organisation of law and custom, economics and industrial life, and the like and to show by a concrete example, the description of a typical tribe or people, how primitive man has solved the specific problem the author has in mind. It is his view that "every type of societal organisation can be encountered among primitive peoples . . . [excepting] representative government".

(2) Dr. Thurnwald, on the other hand, while covering in part the same ground as Dr. Radin, analyses primitive economics by comparative rather than unitary methods, with the view of showing the essential difference in approach to economic problems in a primitive community from that of modern society, owing to the conception of the close interrelation between members and units in a group. It is also his object to show the unreality of the 'three stages' of primitive economic development and the conception of cultural advance along a single line only of previous economic theory, owing to the domination of the views of Darwin and Spencer in the last century. He has brought together a valuable array of facts bearing not merely on food-supply—as he says, rightly, too exclusively the pre-occupation of previous theory—but also on the types of economic life, forms of economic activity, including handicraft, wages, trade, distribution, ownership, etc., and the development of economic methods and simple technical skill, this last illustrated by a series of telling diagrams.

Biology

Scientific Riddles. By Sir J. Arthur Thomson. Pp. 384. (London: Williams and Norgate, Ltd., 1932.) 10*s*. 6*d*. net.

Sir Arthur Thomson divided his last book into four very unequal parts. The first consists of twenty-five brief chapters averaging four or five pages each, most of the titles of which end with a query mark: What is protoplasm? Why do we fall asleep? What are hormones? How does our hair turn grey? The second part contains fourteen somewhat longer chapters discussing such topics as homing, galls, walking in a circle and concluding with an amusing chapter on natural history in everyday conversation which recalls such phrases as 'proud as a peacock', 'raining cats and dogs' and others even more obscure. In Part 3 Sir Arthur treads the borderland between physiology and psychology and gives us six short chapters on animal intelligence, telepathy, dreams, and so on. In Part 4 he sets forth his views on the purpose of evolution, concluding with an epilogue on "The Wonder of the World".

Throughout the volume, Sir Arthur has given full measure of his immense store of biological knowledge, and in his characteristically delightful style.

The book will suggest many problems to the biological student, while for the general reader it shows the present position of knowledge on debated topics, with a wealth of happy analogy and often humorous comment: thus, speaking of protoplasm, Sir Arthur says that it "may be compared to an archipelago with a very large number of small islands on whose multitudinous coastlines there are endless opportunities for brisk trading." Part 4 is a serious contribution to the philosophy of evolution; the remainder is a 'common-place book', for constant reference—and entertainment.

Water-Fowl and Game-Birds in Captivity: some Notes on Habits and Management. By Arthur F. Moody. Pp. 240 + 6 plates. (London: H. F. and G. Witherby, 1932.) 10*s.* 6*d.* net.

THE study of birds in captivity can provide much valuable information, such as the length of incubation and the different stages through which the chicks pass on their way to maturity. In the present volume, we have the author's personal knowledge of how he tended the birds. He gives much information on the construction of aviaries; the varying foods and how to give them; how to handle the birds; how to feather clip and how to pinion them. Under "Vermin" many creatures are included and instructions given for dealing with them. The book ends with a chapter on diseases and how they should be treated.

The volume contains an abundance of information on many different birds and should be welcomed by all aviculturists. Some of the plates are very attractive.

Principles of Soil Microbiology. By Prof. Selman A. Waksman. Second edition, thoroughly revised. Pp. xxviii + 894 + 15 plates. (London: Baillière, Tindall and Cox, 1931.) 52*s.* 6*d.* net.

MUCH additional information has been incorporated in the second edition, but to avoid undue enlargement of the volume the earlier text has been considerably condensed by certain omissions and by the combination of several chapters to avoid unnecessary duplication.

An Introduction to the Scientific Study of the Soil. By Prof. Norman H. Comber. Second edition. Pp. 208. (London: Edward Arnold and Co., 1932.) 7*s.* 6*d.* net.

IN the second edition of this textbook the chief alterations are an expansion of the section on soil microbiology and the re-writing of that dealing with mechanical analysis. Other parts of the book are being brought up to date.

Chemistry

Liesegang Rings: and other Periodic Structures. By Dr. Ernest S. Hedges. Pp. viii + 122 + 8 plates. (London: Chapman and Hall, Ltd., 1932.) 10*s.* 6*d.* net.

ALTHOUGH the Liesegang phenomenon, having engaged the attention of mineralogists, histologists and colloid chemists, has given rise to an extensive and scattered literature, the present work is the first monograph devoted exclusively to the subject. The author gives a full account of the experimental material, beginning with Liesegang's original silver chromate rings and enumerating the numerous other combinations of reactants which have since been found to produce periodic precipitates in certain gels and within certain limits of concentration. He then devotes a chapter to the various theories so far proposed, which have in turn postulated metastable supersaturation, adsorption at the precipitate, membrane formation, variations in the rate of diffusion, periodic coagulation of a colloidal reaction product and periodic inhibition of precipitation by the second (soluble) reaction product as the principal agency. Most of these theories are based on a few, or even on isolated, examples and are incapable of explaining others. This is not really surprising, as there is no *a priori* reason for assuming that the mechanism of periodic precipitation is necessarily the same whatever the reaction producing it.

The author proposes a "comprehensive theory" of periodic phenomena, which however does not at present amount to more than a general qualitative statement of the conditions necessary and (possibly) sufficient for their occurrence, and does not allow one to predict the result in any specific instance.

Interesting chapters are devoted to other periodic phenomena, such as periodic sedimentation and crystallisation, as well as to periodic structures in Nature. A feature of the book is a bibliography containing nearly five hundred references, in which the reviewer has not been able to detect any omissions and has found much that was new to him. The work should stimulate exploration of one of the more curious by-paths of colloid chemistry.

The Structure and Composition of Foods. By Dr. Andrew L. Winton and Dr. Kate Barber Winton. Vol. 1: *Cereals, Starch, Oil Seeds, Nuts, Oils, Forage Plants.* Pp. xiv + 710. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 53*s.* net.

THE name of Dr. A. L. Winton is well known to food technologists for his editing of Leach's "Food Inspection and Analysis" and for his collaboration with Hanausek in "The Microscopy of Technical Products" and with Moeller in "The Microscopy of Vegetable Foods". In this, the first of three entirely new volumes, he has joined with Dr. K. B. Winton, and the work will not in any way replace the earlier books, though it extends and amplifies them; its emphasis is on description, classification, and identification, rather than on the technique of analysis, inspection, or microscopy. It will evidently be considerably larger than the earlier books of which Dr. Winton has been editor or joint author, and, judging by Part I, will form a most comprehensive and well illustrated book of reference.
A. L. B.

Geography and Travel

(1) *Southern Europe: a Regional and Economic Geography of the Mediterranean Lands (Italy, Spain, Portugal, Greece, Albania and Switzerland).* By Dr. Marion I. Newbigin. (Methuen's Advanced Geographies.) Pp. xviii + 428. (London: Methuen and Co., Ltd., 1932.) 15*s*. net.

(2) *The Geography of the Mediterranean Region: its Relation to Ancient History.* By Prof. Ellen Churchill Semple. Pp. ix + 737. (London: Constable and Co., Ltd., 1932.) 21*s*. net.

THESE two volumes, each based on extensive personal travels of the author, are complementary to one another and together will be invaluable to the advanced student of geography.

(1) Dr. Newbigin's volume covers Italy, Spain, Portugal, Greece, Albania and Switzerland and contains also several introductory chapters on the physical geography of southern Europe. In a relatively small compass the conflicting theories of geomorphology are outlined in a way that will be a real help to the student. Climate is treated on a basis of fact free from the simplified generalisations which are too often far from the truth. The various lands are fully treated on a physical foundation and the relegation of statistical matter, except climatic data, to appendices makes the text readable and allows scope for discussion of the broad issues of human response to physical circumstance. There are copious lists of authoritative works and papers and full indications of the maps available for each country.

(2) Prof. Semple's book, on the other hand, deals primarily with the development of human civilisation in the Mediterranean area. The physical background is sketched briefly. Physiographic processes are outside the scope of the book. Climate is considered in its influences, and the sections on vegetation and agriculture are particularly valuable. It is a volume that is packed with information and ideas and every chapter is fully documented. It should become a standard work for geographer and historian alike.

Northern Lights: the Official Account of the British Arctic Air-Route Expedition, 1930–1931. By F. Spencer Chapman. With Additional Chapters by J. M. Scott, Capt. P. M. H. Lemon and Augustine Courtauld. Pp. xvi + 304 + 64 plates. (London: Chatto and Windus, 1932.) 18*s*. net.

FEW arctic expeditions from Great Britain in recent years have succeeded in accomplishing more useful work than that which the late Mr. H. G. Watkins led to East Greenland in 1930. The programme before the expedition was ambitious but much of it was carried out, including the survey of a long stretch of little-known coastline between lat. 64° and 68° N., two traverses of the interior ice cap, the establishment of an ice cap meteorological observatory as well as one on the coast, and various geological and biological investigations.

Many of the details of this work cannot be told in this popular account of the expedition, but enough is said to show that no opportunities were wasted. Two aeroplanes proved useful though they seem scarcely to have given the services that were hoped for. On the ice cap the old-fashioned dog teams were found to be the most serviceable transport. Wireless equipment was a doubtful blessing, in spite of certain advantages.

The story is well told by various members of the expedition. There is no attempt to exaggerate difficulties or to magnify dangers. In fact, the long journeys are described so briefly that they give the reader the false impression of ease. There are several scientific appendices. The book is a notable contribution to arctic literature.

R. N. R. B.

Geology

Petrography and Petrology: a Textbook. By Prof. Frank F. Grout. Pp. xvii + 522. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 30*s*. net.

THE aim of this book is to study the life-history of rocks rather than their description and classification. To this end, perhaps, the author has subordinated petrography to petrology, the result being that some readers may wish he had omitted petrography entirely. The petrographic parts of the book, especially that on the igneous rocks, are very disappointing when compared with the outstanding excellence of the petrological parts. However, these petrographical portions include many good illustrations well worth studying by readers able to neglect the associated letterpress.

In the petrological sections, which follow the petrographies of the igneous, sedimentary and metamorphic rocks in turn, there is given a really excellent account of modern views on the origin of rocks. An attempt is made to separate fact from theory, and the author is not engaged in boosting a theory of his own—a circumstance to be thankful for nowadays in a work accessible to students.

The modern American points of view on igneous and sedimentary petrology are well known to European geologists, but not so that on metamorphism. In this field it seems that the Europeans are more likely to fulfil the author's aim—interpretation of rocks in terms of history—than are his countrymen.

The sets of mineral tables given are not necessary in a book such as this. A list of selected readings is a welcome feature, though certain omissions, such as Eskola, Sederholm, Sander and others from the metamorphic section, will be noticeable to European readers.

In summary, this book, in spite of its petrographical blemishes, is a very valuable contribution to the general literature on the origin of rocks.

Der Bau der Erde und die Bewegungen ihrer Oberfläche: eine Einführung in die Grundfragen der allgemeinen Geologie. Von Prof. Dr. W. von Seidlitz. (Verständliche Wissenschaft, Band 17.) Pp. ix + 152. (Berlin: Julius Springer, 1932.) 4.80 gold marks.

THIS little book is an excellent introduction to present-day geological thought. The classic question, first answered by Leonardo da Vinci, as to why sea shells are found in the rocks of high mountains, is here put again, and answered on modern lines.

The origin of rocks is lucidly explained on sound uniformitarian principles. It is worth noting, however, that the author directs attention to certain limitations in *Aktualismus*, as, for example, those due to the circumstance that the moist vegetation-covered Europe of to-day furnishes none too reliable a clue to the past.

The main part of the book is concerned of course with the movements to which the earth's crust has been subjected. The contrasts between the rapid, violent movements of the orogenic or mountain-building belts and the slow vertical movements of the more stable areas are developed. But, as we would expect from the author of "Diskordanz und Orogenese der Gebirge am Mittelmeer", we find the importance of the broad epirogenic movements consistently emphasised. The integration of minute movements leads to transgressions and regressions, and thus produces results of fundamental importance for earth history. One of the most interesting parts of an interesting book is that dealing with the detection of epirogenic movements in action at the present day. Further, positive uplift is considered to be the chief cause of mountains: "the mountains grow from the depths, and are still growing".

The book concludes with a table of geological formations, short bibliography, a glossary, and index.

A Textbook of Mineralogy: with an Extended Treatise on Crystallography and Physical Mineralogy. By Prof. E. S. Dana. Fourth edition, revised and enlarged by Prof. William E. Ford. Pp. xi + 851. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 34*s*. net.

CERTAIN additions and much revision, as compared with the third edition of 1922, have been made in this new edition of E. S. Dana's well-known textbook. The chief additions are two. The crystallography section now includes a short account of crystal structure, as revealed by X-ray analysis, which provides a good introduction to an increasingly important branch of mineralogy. A section entitled "Origin, Mode of Occurrence and Association of Minerals" is new to this book, though much of it has appeared in Dana's "Manual of Mineralogy". This section consists of less than twenty pages, so that only a very inadequate summary of mineral paragenesis is presented.

The descriptive part of the book has been revised, the most recent data incorporated, and accounts of more than two hundred new minerals added. Descriptions, short or long, of all known minerals are given. It has been Prof. Ford's aim to give the important facts of mineralogy as known "on January 1, 1932". In this, so far as a work of this kind can be tested, he seems to have succeeded.

Mathematical and Physical Sciences

British Association for the Advancement of Science. Mathematical Tables. Vol. 1: *Circular and Hyperbolic Functions, Exponential Sine and Cosine Integrals, Factorial (Gamma) and Derived Functions, Integrals of Probability Integral.* Prepared by the Committee for the Calculation of Mathematical Tables. Pp. xxxvi + 72. 10*s*. Vol. 2: *Emden Functions: Being Solutions of Emden's Equation, together with Certain Associated Functions.* Prepared by the Commission for the Constitution of the Stars of the International Astronomical Union and the British Association Committee for the Calculation of Mathematical Tables. Pp. viii + 34. 7*s*. 6*d*. (London: British Association, 1931 and 1932.)

FROM 1873 onwards, at irregular intervals, the British Association has published in its annual report various mathematical tables. Unfortunately, these were generally compiled for special purposes, and when regarded as a whole were not well suited for general use. To remedy this defect a committee undertook the heavy task of filling the gaps and (a point altogether neglected in the original form) making them suitable for interpolation. The first volume, begun by R. A. Fisher and completed by J. Henderson, with the assistance of J. R. Airey, L. J. Comrie, A. T. Doodson, A. Lodge, J. Wishart, and others, contains sixteen tables. Some of these are new, and two of them (dealing with tetragamma and pentagamma functions) are the only tables of these functions in existence. The degree of accuracy is high, extending (except in the last) from ten to fifteen decimal places. There is an elaborate introduction filling thirty pages, beginning with interpolation, using Everett's formula and central differences of even orders, for which these tables are specially suitable. After a brief treatment of the better-known functions, the introduction concludes with an extensive account of the properties of certain probability repeated integrals (really Hermite functions) and their applications to statistics.

The second volume is entirely devoted to solutions of Emden's differential equation, which is fundamental in modern theories of the internal structure of the stars, and to certain auxiliary functions. The work, undertaken at the request of Sir Arthur Eddington, was carried out by J. R. Airey, J. C. P. Miller, and D. H. Sadler.

H. T. H. P.

The Queen of the Sciences. By Prof. E. T. Bell. (A Century of Progress Series.) Pp. iv + 138. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1931.) 5*s*. 6*d*. net.

THIS fascinating little volume opens with the famous words of Gauss, "Mathematics is queen of the sciences and arithmetic the queen of mathematics. . . ." Prof. Bell takes us from the objects and descriptions of mathematics through the development of systems of algebra, groups and matrices, the Einstein geometry, etc., to Hilbert's logic. Whilst, however, the manifold applications of mathematics are briefly touched upon, especially in the chapter on groups, the treatment rather follows the aim set forth by Jacobi, who, when reproached by the applied mathematician, Fourier, retorted, "The true end of mathematics is the greater glory of the human mind". Indeed, the progress of the century is aptly summarised by the author in the words, "Ever greater generality and ever sharper criticism".

One feels that many of the excellent illustrations are a little too brief to be really effective: just a slightly fuller explanation here and there would not only have safeguarded essential principles being misinterpreted, but would also have made a greater appeal to the lay reader. It is surprising to find no mention of Boole in the chapter on the development of algebra.

The whole book, nevertheless, is extremely interesting, for it tends to broaden the mathematical horizon of the reader, and especially so in the case of a student whose vision has been partially dimmed by the artificial boundaries of examination syllabuses. Here, too, the mature mathematician may derive renewed inspiration. A few references to original sources of some of the topics discussed would have enhanced considerably the value of these.

The Exponential and Hyperbolic Functions and their Applications: a Practical Book for the General Student and Engineer. By A. H. Bell. (Technical School Series.) Pp. x + 82. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 3*s*. 6*d*. net.

THIS little book deals with the practical applications of exponential and hyperbolic functions as required in engineering, physics, etc. Only an elementary knowledge of trigonometry and calculus is assumed. The treatment, whilst not rigorous, is carefully thought out and written. There is, however, a grave danger in not warning the student sufficiently of the necessity of justifying certain operations. Even in subordinating rigour to practical utility, it is nevertheless essential to point out clearly what assumptions have been made and to state that the validity of such assumptions requires further investigation. Especially is this necessary in dealing with series. Yet, on pp. 46–50 it is assumed, without comment, that a circular function is expressible in a valid series, and that the process of differentiation may afterwards be applied to the supposed identity.

The text is well illustrated by fully worked out practical examples, and a fair number of exercises are provided for the student. It is curious to see logh written for $\log_e$. There is an unfortunate misprint on p. 3 where *ex* appears in thick type for e^x.

Advanced Algebra. By Clement V. Durell. Vol. 1. Pp. viii + 193 + xxii. (London: G. Bell and Sons, Ltd., 1932.) 4*s*.

THIS book, originally intended to be Part 4 of the author's "New Algebra for Schools", deals comprehensively with the Higher Certificate requirements. The topics discussed include permutations, combinations, finite series, limits, convergence, logarithmic, exponential and quadratic functions, theory of equations and determinants. The treatment is not only thoroughly sound but also fascinating, the student's interest being stimulated from the beginning. In accord with modern experience, Mr. Durell has not hesitated to introduce calculus methods where necessary. The long, cumbersome and often fallacious methods of the older books have therefore been replaced by valid and elegant proofs. Especially is this manifest in the excellent chapter devoted to the logarithmic and exponential functions, which most teachers will appreciate.

The treatment of limits and convergence, which is often dull, is well adapted to the ordinary pupil, and reveals the author as a practical teacher who knows how to present to young students a difficult part of the subject.

A new book on advanced algebra is long overdue, and teachers will be grateful to Mr. Durell for so ably providing the needed volume.

Recent Advances in Atomic Physics. By Prof. Gaetano Castelfranchi. Approved translation by Dr. W. S. Stiles and Dr. J. W. T. Walsh. Vol. 1: *Atoms, Molecules and Electrons.* Pp. xii + 360 + 12. Vol. 2: *Quantum Theory.* Pp. xii + 400 + 12. (London: J. and A. Churchill, 1932.) 15*s*. each vol.

THE two volumes before us constitute the latest addition to a well-known series dealing with "Recent Advances in Science". Up to the present, we have been able to 'Buy British'; now, if we wish to study "Recent Advances in Atomistics", we have to turn to an English translation of an Italian work, of which three editions have appeared in two years. Well, this is very good free trade and sound internationalism; the book is good of its kind, and may be unequivocally welcomed. It is something of a feat to present in compact form a general introduction to the fundamentals of physical atomic theory, with a discussion on wave motion and kinetic theory, and then to proceed, chapter by chapter, to give succinct accounts of fluctuations, electrons and positive rays, isotopes, X-rays, crystals, radioactivity, nuclear properties, radiation and the quantum theory, spectroscopy, the Stark and Zeeman effects, specific heats, the photoelectric effect, the Compton effect, wave and quantum mechanics, and the new statistics; the whole exposition being completed within the compass of 800 small octavo pages.

It is small wonder that the translators, who have executed their task most competently and critically, decided to omit those sections of the Italian edition which deal with Brownian motion, relativity and astrophysics. It might, in fact, have been better had a few more sections, or some of the more elementary topics, been omitted, and the remainder expanded a little; for modern physical theory is full of subtleties, and a highly condensed treatment is apt to leave a delusive feeling of ease of comprehension that vanishes with a little further thought. This apart, the volumes give an interesting and informative account of modern atomistics, developed in such a way as to make a minimum of demand on the reader's mathematical knowledge; moreover, the author has, very wisely, kept close enough to experimental and technological matters to include brief résumés of such topics as television, supersonics and phototelegraphy.

A. F.

Physical Principles of Mechanics and Acoustics. By Prof. R. W. Pohl. Authorized translation by Winifred M. Deans. Pp. xii + 338. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1932.) 17*s.* 6*d.* net.

Two years have elapsed since the English edition of Prof. Pohl's "Physical Principles of Electricity and Magnetism" was published, and many teachers of physics who were charmed with the novelty of his treatment and the ingenuity of his experiments will welcome this new volume on mechanics and acoustics. The numerous diagrams and illustrations at once attract attention. Most of the figures are based on photographs, and several have been made into silhouettes. It is claimed that this simple method of reproduction indicates whether an experiment is suited to a large lecture-room, as it is then important that the outlines should be clear and uninterrupted. Prof. Pohl tells us that in the Göttingen lecture-room that "troublesome obstacle, the large fixed lecture-table, was got rid of years ago". Small handy tables are set up as required. "The apparatus in actual use at any moment can be made to stand out so that it is easily seen by each member of the audience." Special mention ought to be made of the plates illustrating streamline flow in liquids and gases, and of the exceptionally clear photographs of waves on the surface of a liquid and of sound waves in air by the *schlieren* method.

The subjects treated in the text are those familiar in elementary courses on mechanics, but even the experienced teacher will find much to rouse his own interest and in turn that of his students. The human aspects of the subject are not lost sight of, as for example in discussing the translation and rotation of a man, and the free axes of rotation of human beings and animals. Excellent accounts are given of the motion of liquids and gases, and also of waves and vibrations.

H. S. A.

Numerical Examples in Physics. By Dr. W. N. Bond. Pp. 128. (London: Edward Arnold and Co., 1931.) 4*s.*

This book of some 450 numerical examples in physics, with answers set forth very clearly, covers a remarkably wide range and will be of great use to advanced students of the subject, particularly those reading for a special or honours degree. Nothing like it has hitherto appeared, and the university teacher, who has long felt the want of something parallel to the several excellent books of numerical examples in advanced physical chemistry, will undoubtedly give it a warm welcome.

Dr. Bond is to be congratulated on starting with a section on methods of calculation; and the examples on calibrations, probable error, order of accuracy and curve fitting inculcate the right spirit at the outset. The largest section is naturally on classical electricity where the variety of question is excellent, problems on inductances and ballistic galvanometers and on absolute determination of current and resistance being most instructive. Of particular note is the unique section on atomic physics giving numerical examples on the determination of electronic charge and mass, on Avogadro's number, crystal structure, photoelectrons, the magneton, X-ray scattering, Planck's constant and radioactivity. A few odd questions, not even semi-numerical, have crept into several sections, and might be omitted. Question 132, which deals with special units, has an answer for the mass of the sun of 1·47 kilometres, and question 245 deals with the spectrum produced by a glass prism of refractive index 1·961! But these are mere slips, and there can be nothing but praise for this remarkably comprehensive collection, of the range and quality of which the title gives no indication.

Miscellany

Osiris and the Atom. By J. G. Crowther. Pp. viii + 221 + 4 plates. (London: George Routledge and Sons, Ltd., 1932.) 5*s.* net.

This is a collection of notes and essays of 'popular science' which is actually both popular and on the whole scientific. Mr. Crowther has a chatty, interesting style, the gift of making fairly complex matters readily understood, and a true journalistic instinct for the arresting phrase. The title of the book, "Osiris and the Atom", is an example of the latter; the contest for the soul between the forces of life and death in ancient Egypt is the root idea from which ball games have developed, and the peculiarities of bounding and spinning balls provide useful analogies in the study of atoms. The phrase also expresses aptly the wide range of the book—the great Siberian meteorite, human biology, the structure of wool fibres, modern advances in engineering, Thames floods, terrestrial magnetism, the constitution of the stars, viruses and vitamins.

The author has travelled widely in search of material, visiting Prof. Kulik in Russia for example to discuss the Siberian meteorite. This and the chapter on the structure of wool fibres are especially good, but a few, such as the sketch of "magnetism in the universe", are too superficial to be of real interest. It is curious that the author should have made so elementary a mistake as that on p. 141, where the average air pressure over the oceans is said to be 28 inches. The last article is entitled "Basic English", and is included because the author realised that "a science expert writing for the public has necessarily to make use of a sort of Basic English". The article reads so fluently and naturally that it comes as a shock to find at the end that it is itself written in Basic English.

The Problem of Incentives in Industry: Three Lectures given at the London School of Economics under the Heath Clark Bequest to the National Institute of Industrial Psychology. By Dr. G. H. Miles. Pp. v + 58. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 3*s*. 6*d*. net.

THE three lectures contained in this volume give a popular analysis of the various classes of incentives, including fear and financial incentives, non-financial incentives such as appreciation, knowledge, loyalty, welfare schemes, co-operation, and special incentives like responsibility and promotion which affect those holding management positions. The dangers and limitations of particular types of incentives are discussed and Dr. Miles asserts that the essential problem is that of the development of human power.

Incentives which are designed and applied to increase the general welfare of the worker and his interest in life and work do far more than merely augment output and increase the profits of industry. Those who hold with Dr. Miles that the ultimate purpose of industry is the amelioration of the conditions of life of society in general will welcome the issue to a wider public of this lucid statement of general principles. R.B.

Muscular Work, Fatigue and Recovery: Three Lectures given under the Heath Clark Bequest to the National Institute of Industrial Psychology. By G. P. Crowden. Pp. ix + 74 + 6 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 3*s*. 6*d*. net.

THESE lectures outline certain aspects of the rationalisation of industrial work in the light of the physiological requirements of the human body. They describe in a popular and readable manner the way in which the scientific principles determining human efficiency and fatigue are being elucidated and indicate the contribution which this branch of industrial physiology has to make to human welfare in industry. The survey is not limited to the investigations of British workers alone but also includes a brief description of the Dortmund Institute for the Study of the Physiology of Labour.

The influence of such factors as ventilation, temperature, clothing and food is indicated and this clear and concise statement of the methods of science in this field should stimulate that enthusiastic co-operation among trade unionists, employers, scientific workers, and employees which is essential if full use is to be made even of the knowledge already acquired. R.B.

Philosophy and Psychology

A History of Psychology in Autobiography. (The International University Series in Psychology.) Vol. 2. By Benjamin Bourdon, Harald Höffding, James Drever, Charles H. Judd, Knight Dunlap, C. Lloyd Morgan, Giulio Cesare Ferrari, Walter B. Pillsbury, Shepherd Ivory Franz, Lewis M. Terman, Karl Groos, Margaret Floy Washburn, Gerardus Heymans, Robert S. Woodworth, Robert Mearns Yerkes. Edited by Carl Murchison. Pp. xvii + 407. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1932.) 28*s*. net.

THE first volume of this work was noticed by us at the time of its appearance. We think that the editor and his co-adjutors were quite justified in their view that the history of recent psychology could scarcely be written, and that indeed a comprehensive statement about present trends in psychology could scarcely be made, without such help as this great work affords. Furthermore, to many readers the personal note which runs through each of these records will prove an aid to understanding, although we must express our conviction that a good deal of the autobiographical detail is superfluous. Still, the work is an important one, and one that reflects credit upon every person concerned in its production.

David Hume. By Dr. B. M. Laing. (Leaders of Philosophy Series.) Pp. xi + 273. (London: Ernest Benn, Ltd., 1932.) 12*s*. 6*d*. net.

AT a time when the extraordinary wealth of our knowledge in all directions threatens our sense of values with conflicting conclusions and assumptions, Hume's scepticism finds a renowed actuality. Dr. Laing's able monograph gives the right historical and philosophical setting of Hume's doctrines, and will no doubt encourage his readers to a closer study of Hume's writings. They will thus find out for themselves that Hume's influence on scientific investigation, or on the theory of it, is strongest where the experimental method and its presuppositions are stressed. But the important part played by mathematics in physical science has set limits to his influence in this direction because of doubts concerning the adequacy of his theory in this respect. T. G.

Berkeley. By Prof. G. Dawes Hicks. (Leaders of Philosophy Series.) Pp. xii+336. (London: Ernest Benn, Ltd., 1932.) 12*s.* 6*d.* net.

THIS is a valuable addition to the series of monographs on the philosophers who have mainly influenced Western thought. Much has been written already on Berkeley; yet Prof. Dawes Hicks succeeds in being both original and interesting in his account of the Bishop of Cloyne. In the exposition of Berkeley's doctrine, he rightly stresses the importance of his opinions about mathematics and the sciences for the understanding of his philosophical views; and the section devoted to Berkeley's place in history adds some fresh material to the valuation of this most fascinating thinker. T. G.

Technology

A Dictionary of Electrical Terms: including Telegraphy, Telephony and Wireless. By S. R. Roget. Second edition, revised and enlarged. Pp. vii+396. (London: Sir Isaac Pitman and Sons, Ltd.; 1931.) 7*s.* 6*d.* net.

So rapid has been the progress made in various branches of electrical science that even scientific workers themselves have sometimes to look up many of the latest treatises published before they find the definition of the term or phrase they are looking for. We have looked up many words such as bel, néper, booster, in this dictionary, and have found clear and satisfactory definitions. Purely trade names of apparatus have been omitted. The use of many technical terms in the electrical industry is almost entirely confined to the United States; but some which originated there are equally used on both sides of the Atlantic; the author gives both. Conciseness has been attained without the sacrifice of intelligibility and the author does not trespass on the function of the encyclopædia or the technical treatise.

In the second edition more than nineteen hundred further expressions have been added and a good many alterations have been made. The author's purpose has not been to compete with the officially established definitions compiled by the British Standards Institution and by the International Electrotechnical Commission. His purpose has been to give explanations rather than definitions. The dictionary should prove useful to many.

Advanced Electrical Measurements. By Dr. William R. Smythe and Dr. Walter C. Michels. Pp. x+240. (New York: D. Van Nostrand Co., Inc., 1932.) 3 dollars.

THE object of this book is to train students so that they may be useful in research, testing and development work. Perhaps it is too much to hope that all the information given can be assimilated in thirty laboratory lessons; but the book can be commended. It is stated (p. 101) that "the growth of modern physics dates from the time of the conception of the electrical theory of matter". If this is regarded as the definition of 'modern physics', evidence can be produced in support of it, but we think that it rather limits its scope.

Comparing this book with similar books published thirty or forty years ago, it will be seen how the methods given of measuring, for example, inductance and capacitance, have improved in the direction of attaining higher precision, but possibly they are less instructive. Students now experiment with various kinds of alternating current bridges, ionisation gauges and hot wire manometers. Photoelectric cells and optical manometers are also used. The mechanisation of laboratory experiments is proceeding so rapidly that there is little time to develop originality. The proof reading seems to have been carelessly done as there are variations in the spelling of the names of continental physicists.

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Letters to the Editor

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Molecular Weights of the Blood Pigments of the Invertebrates

BY means of the ultra-centrifugal method, it has recently been shown that the red blood pigment of the annelids is not identical with the hæmoglobin of the vertebrates as was previously assumed, but is a protein more allied to chlorocruorin and hæmocyanin with regard to molecular weight[1]. It was suggested that a comparative study of the properties of the respiratory proteins throughout the animal kingdom might bring to light interesting relationships between the various groups of animals. Such an investigation has now been started, and although so far only some forty species have been studied, a number of regularities have been found which seem to merit general attention.

Four types of respiratory proteins are known from the blood of the invertebrates, a red pigment (erythrocruorin), a green pigment (chlorocruorin), a blue pigment (hæmocyanin) and a pigment of reddish brown colour (hæmerythrin). In the following, only the first three types will be considered.

Of the erythrocruorin type we have found five different forms dissolved in the blood and two forms in blood corpuscles differing with regard to sedimentation constant. Each of the five forms of the first type is characteristic of one of the following groups of invertebrates: oligochæte worms, polychæte worms, gastropods, crustaceans, insects. The two forms of the second type have been found in the erythrocytes of the capitellide and glyceride worms. For the chlorocruorin type only one sedimentation constant has been observed. For the hæmocyanin type we have found six sedimentation constants representing the following animal groups: gastropods, cephalopods (two different constants), xiphosurans, crustaceans (three different constants). Within some of these groups several species have been studied, all of which give the same sedimentation constant with a probable error of about 2 per cent. It is not possible to determine the molecular weight with the same degree of accuracy, but the fact that the sedimentation constants agree so closely makes it extremely probable that the molecular weights are also almost identical.

Among the polychæte worms six species belonging to six different families possess respiratory pigments with the same sedimentation constant, namely, $57{\cdot}5 \times 10^{-13}$ (corresponding to a molecular weight[3] of 2,850,000). Among the gastropods no less than eleven species representing seven different families show the same sedimentation constant of $99{\cdot}5 \times 10^{-13}$ (corresponding to a molecular weight[3] of 5,000,000) and among the crustaceans five species of three families have the constant $23{\cdot}0 \times 10^{-13}$[2]. The lowest sedimentation constant for a respiratory pigment dissolved in the blood is found for the erythrocruorin of the insects (*Chironomus* larvæ). It is only about half that of the constant of the hæmoglobin of the vertebrates and therefore corresponds to a comparatively very low molecular weight. Only a few invertebrates possess red blood corpuscles. So far, we have only had the opportunity of studying the respiratory proteins from two such species. It is noteworthy that in both cases low sedimentation constants were found.

The constancy of the molecular weights of the respiratory blood proteins within various animal groups becomes still more puzzling when the following facts are taken into consideration. The erythrocruorin and the chlorocruorin of the polychæte worms, the erythrocruorin of *Planorbis* and the hæmocyanin of *Calocharis*, the erythrocruorin of the polychæte worms and the hæmocyanin of *Sepia* and probably the erythrocruorin of *Daphnia* and the hæmocyanin of *Eupagurus* have identical sedimentation constants and therefore probably identical molecular weights. The measurement of the absorption of light in the visible part of the spectrum for the blood proteins of the gastropods has further shown that the hæmocyanins of *Helix*, *Paludina* and *Littorina*, which have the same molecular weight, nevertheless are distinctly different with regard to the chemical constitution of the active group of the molecule. A detailed and systematic investigation of the isoelectric points of the respiratory proteins of the invertebrates, now being carried out in this laboratory by Dr. K. O. Pedersen, has brought to light another circumstance of considerable importance. He has found that, as a rule, each species is characterised by a special value of the isoelectric point of its blood pigment. This means that the chemical composition of the blood pigment varies from one species to another, although the mass of the molecule remains practically constant.

It seems, therefore, that only a few molecular masses are stable and that it would depend upon the composition of the molecule with regard to various amino-acids whether one or the other of the different possibilities is realised. The constancy of the molecular weight within a certain animal group would then be a measure of the similarity of certain chemical processes leading to the formation of the respiratory protein.

The regularities in the sedimentation constants which we have found seem to justify an effort to extend this investigation to other species and other groups of animals possessing respiratory proteins.

THE SVEDBERG.
ASTRID HEDENIUS.

Laboratory of Physical Chemistry,
University of Uppsala.
Jan. 21.

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[1] T. Svedberg and Inga-Britta Eriksson, NATURE, 130, 434, Sept. 17, 1932.

[2] Unpublished determination by Miss I.-B. Eriksson.

[3] T. Svedberg and E. Chirnoaga, *J. Amer. Chem. Soc.*, 50, 1399; 1928.

Virus Diseases and Intracellular Inclusions in Plants

VIRUS diseases of both plants and animals are often characterised by the production of abnormal inclusion bodies within the cells of the host. The bodies are usually of more or less spherical form and are protein in nature. Although they commonly accompany virus diseases, they have not been found to occur in hosts infected with any other type of disease, nor are they at all similar to the many intracellular inclusions formed in normal healthy plants.

These virus inclusion bodies have attracted much attention and various theories as to their origin and significance have been advanced. New light was recently thrown on the problem by a study of the response of the cells of several Solanaceous hosts to infection with aucuba mosaic of tomato[1]. The first symptom of the virus attack to become apparent was an increased activity of the cell contents; the cytoplasm became more conspicuous and flowed more rapidly. Then minute particles of protein appeared in the cytoplasm which carried them passively about the cell. These particles aggregated and fused to form a few large masses; the latter ultimately coalescing to give a single mass which became compact and rounded. The mode of formation of these bodies lent support to the view that they are essentially products of reaction of the host cell to the virus. The question then arose as to whether similar effects could be induced in plant cells by physico-chemical means.

The species used in the study of aucuba mosaic disease included, among others, *Solanum nodiflorum*, *S. nigrum* and *S. lycopersicum*. Healthy plants of these three species were treated with small doses of chemical substances known to cause coagulation of protoplasm. The latter comprised mineral acids and salts and organic compounds such as acids, alcohols and alkaloids. Each of these reagents produced, in greater or lesser degree, symptoms similar to the first microscopic evidence of a virus attack: the cytoplasm became increasingly conspicuous and its streaming was accelerated. In some cases, hyaline spheres, similar to bodies which accompany certain virus diseases, were produced. These, however, always proved ephemeral; their movement about the cell might be followed for some hours but suddenly they would be lost into the general mass of plasm.

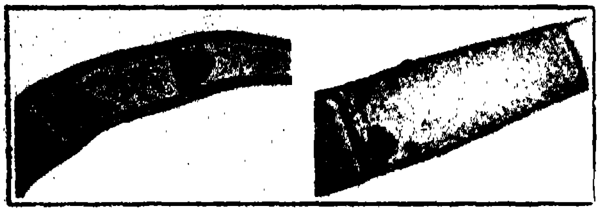
(*a*) (*b*)

FIG. 1. (*a*) Intracellular inclusions in cells of hair from *Solanum nodiflorum* infected with aucuba mosaic disease. (*b*) Intracellular inclusion formed in a hair cell of *S. nodiflorum* as a result of treatment with ammonium molybdate. Magnification, about 220.

With one radicle it was possible to induce in the cells processes analogous to all stages of an attack of aucuba mosaic disease. Molybdenum, given in the form of molybdic acid, or its ammonium or sodium salts, produced these phenomena, but it has not been possible to reproduce them with any chemically related substance. Soon after treatment began, the cytoplasm became more conspicuous and seemed to increase in volume. It streamed more rapidly, then minute yellowish particles appeared in it and were carried about the cell. When brought together by the flowing of the plasm, these particles coalesced. By aggregation and successive fusions a single large mass was gradually built up. The body, as finally formed, was rougher in outline and slightly more granular than those produced by infection with aucuba mosaic, to which it appeared to be essentially analogous (Fig. 1).

As all produced similar preliminary effects, it is not obvious why the molybdate radicle should induce a much closer imitation of the microscopic effects of the virus than did any other chemical reagent used. If an adequate control could be exercised over conditions within the cell, it is possible that other coagulants might induce similar effects, but this introduces many technical difficulties which cannot at present be overcome.

F. M. L. SHEFFIELD.

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Rothamsted Experimental Station,
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[1] *Ann. App. Biol.*, 18, 471-493; 1931.

Recrystallisation Power and Shear Hardening in Aluminium Single Crystals

RECRYSTALLISATION experiments with stretched aluminium single crystals seem to indicate that, for the same amount of shear*, the number of crystallites formed under identical conditions of heat treatment is the smaller the greater the number of slip-planes involved in the distortion.

This behaviour can be readily understood with the aid of the results obtained in a former investigation of the recrystallisation of homogeneously deformed aluminium single crystals[1], in which it was shown (1) that the nuclei of the new crystallites are formed in the locally curved regions of the slip planes (see Fig. 1), which, according to G. I. Taylor and other investigators[2], are brought about as a necessary consequence of the fact that the actual slipping is initiated along limited parts of the planes of slip [which parts may be generally denoted as *Lockerstellen* (Smekal)]; (2) that the number of crystallites formed increases rapidly with the increase of curvature of these locally deformed regions, and therefore with the amount of shear along the slip-planes.

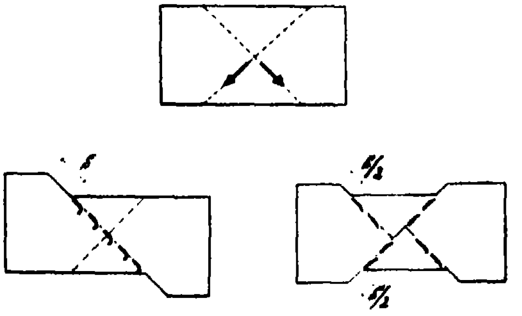

FIG. 1. Diagrammatic representation of locally curved regions along the slip planes.

If now a given 'total shear' is divided over several intercrossing planes of slip, it may be expected to lead to deformed regions of, in the mean, weaker 'curvature' than if the whole shear has taken place along only one such plane. This is schematically illustrated by the accompanying figure (Fig. 1). As a consequence thereof, the number of crystallites formed on recrystallisation is much less in the first case than in the second.

Now it is known from investigations of Taylor[3] and from those of R. Karnop and G. Sachs[4] that during plastic extension or compression of aluminium single crystals, the resistance against slip seems to be not materially influenced (or if so, then slightly increased) by a 'division' of the slip over several planes: in fact, the shear-hardening practically only depends on the 'total amount' of shear. In connexion with this, the possibility arises for aluminium of the *simultaneous occurrence of smaller recrystallisation power and greater hardening* and vice versa.

With the aid of this conception it has been possible to understand in principle the results obtained by several investigators[5], in which this non-parallelism between hardening and recrystallisation power has been demonstrated.

The experiments also permit us to understand why large aluminium crystals, grown by recrystallisation of strained polycrystalline test pieces, seem to favour a position in which a [110] direction is parallel to the direction of straining[6]. This can be related to the fact which has been shown experimentally, that the recrystallisation power is, in general, greatest for aluminium crystals which have been stretched in a direction approaching the [110] direction, the reason for which seems to be that in this direction the probability of the occurrence of *multiple* slip (along 'forbidden planes') is smallest. Therefore it seems probable that on stretching a polycrystalline aggregate, a crystal grain of such orientation will serve as nucleus for the single crystal formed on heating.

I wish to thank Mr. J. J. A. Ploos van Amstel for his valuable help with these experiments. For details I refer to the *Zeitschrift für Physik*, in which they will be published shortly.

W. G. BURGERS.

Natuurkundig Laboratorium
der N. V. Philips' Gloeilampenfabrieken,
Eindhoven, Holland.
Nov. 24.

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[*] The 'amount of shear' is defined by the relative displacement of two parallel planes of slip at unit distance.

[1] W. G. Burgers and P. C. Louwerse, *Z. Phys.*, **67**, 605; 1931. *Metallw.*, **11**, 251; 1932.

[2] *Trans. Far. Soc.*, **24**, 121; 1928. Compare also A. Müller, loc. cit., 173; H. J. Gough, 137.

[3] *Proc. Roy. Soc.*, A, **116**, 39; 1927.

[4] *Z. Phys.*, **41**, 116; 1927.

[5] See, for example, P. Beck and M. Polanyi, *Z. Elektrochem.*, **37**, 521; 1931. A. E. van Arkel and M. G. van Bruggen, *Z. Phys.*, in the press.

[6] See, for example, C. F. Elam, *Phil. Mag.*, (6), **50**, 517; 1925. G. Sachs and J. Weerts, *Z. Phys.*, **59**, 497; 1929.

Debye's Dispersion of Nitrobenzene

ACCORDING to Debye, dispersion must take place in polar liquids around a frequency ν given by the expression:

$$\frac{1}{2\pi\nu} = \tau = \frac{\zeta}{2kT} \qquad (1)$$

where *T* is the so-called time of relaxation, *k* is Boltzmann's constant, *T* is the absolute temperature and ζ is a constant corresponding to the internal friction which prevents the polar molecules from rotating freely. In the case of spherical molecules, to which Stokes's law can be applied

$$\zeta = 8\pi\eta a^3 \qquad (2)$$

where η is the coefficient of viscosity and *a* the radius of the molecules. The time *T* is of the order of 3×10^{-11} seconds for water and this period corresponds to a wave-length of about 1 cm. In order to bring the dispersion in a region of wave-length more accessible to undamped oscillating circuits, one can dissolve the polar liquids in very viscous nonpolar solvents, as has been shown by Williams and Johnstone[1]. This procedure has another advantage, namely, that of eliminating the spurious effects of molecular association always present with polar substances.

We have dissolved different polar molecules in Shell oil BL 3, which has a coefficient of viscosity of about 5 poises at 35° C., and we have measured the dielectric constant of these solutions for eight wave-lengths between 328 m. and 18 cm.

The small value of the dielectric constant of the oil ($\varepsilon = 2 \cdot 32$) has led us to believe that its molecules were not polar. We verified that the pure solvent showed *no dispersion in the region studied*. For the polar solutions, however, we obtained two regions of dispersion. A typical curve is given in Fig. 1 for two concentrations of nitro-benzene. These two dispersions follow separately and closely the law predicted by Debye.

In order to explain the presence of these two regions of dispersion, we have been led to assume that they correspond to two different types of resisting media in which the molecules can rotate. The region of relatively long wave-length would be brought about by *the friction with which the oil* molecules hinder the rotation of the nitrobenzene polar molecules. The second region would be due to the viscous forces of nitrobenzene itself. Thus our experiments would show that when nitrobenzene is dissolved in viscous oil, some of its molecules form a sort of aggregate while others are relatively free. This view is in complete accord with measurements of the dispersion of amyl and butyl alcohol which we have made and with measurements of this dispersion as a function of the temperature.

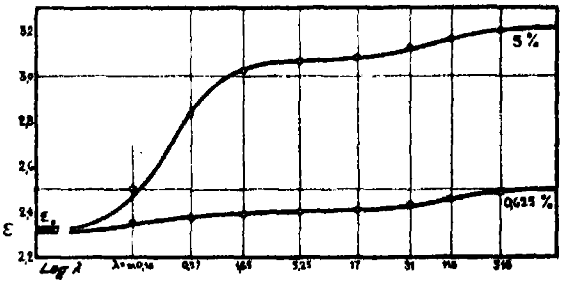

FIG. 1. Dispersion of nitrobenzene at 20°C in Shell oil BL 3.

A more detailed account of this work, which forms the dissertation of one of us (R. L.), is to appear soon in the *Helv. Phys. Acta*.

J. WEIGLE.
R. LUTHI.

Institute of Physics,
University of Geneva.
Jan. 20.

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[1] Williams and Johnstone, *Phys. Rev.*, **34**, 1483; 1930.

Reversal of Current in Rectifier Photo-Cells

I HAVE just seen the letter on the above subject by Messrs. H. H. Poole and W. R. G. Atkins in NATURE of January 28. I encountered the phenomenon to which they refer about three months ago when determining the spectral sensitivity of some gold—cuprous oxide—copper cells of the Auger type, but refrained from directing immediate attention to it as it was apparent from an examination of the results that further work was required before a completely satisfactory explanation was forthcoming.

That the cuprous oxide—copper junction is the essential factor in producing the reversal, as suggested by Messrs. Poole and Atkins, is certain, because in cells which I have since been able to examine by the courtesy of the Westinghouse Brake and Saxby Signal Co., in which there is no copper backing to the gilt cuprous oxide layer, no signs of the reversal near 0·6μ are obtained. On the other hand, these cells show a small, but definite reversal in the ultra-violet.

There is no doubt that the wave-length of reversal and the magnitude of the reverse current depend on the thickness of the gold film and also, probably, on the thickness of the oxide layer. The variability of the effect over the surface of the cell described by Messrs. Poole and Atkins suggests that the gold was much thinner than in the cells I have used. The magnitude of the reversed maximum is also apparently greater, which points in the same direction. On this point, however, I would be glad to know if the figures given have been reduced to an 'equal energy spectrum', or if they relate to the intensities obtained in a spectroscope uncorrected for dispersion or for the energy distribution in the spectrum of the source used. I am hoping to obtain, in the not too distant future, the necessary data on the spectral transparency of the gold films and of the cuprous oxide layers to provide a reasonably convincing explanation of the behaviour of these cells.

I note that Messrs. Poole and Atkins found no reversal in a silver-sputtered cell. It may be of interest to mention that with a silvered cuprous oxide cell *without copper backing*, also prepared by the Westinghouse Co., I have found a reversal to occur at the blue end of the visible spectrum. The cell has only recently come into my hands and I have not carried out sufficient tests to see whether any return to the original polarity occurs at still shorter wave-lengths, but the indications are that this is unlikely. These cases differ from that of the gold—oxide—copper cell inasmuch as there is here only one rectifying surface, that between the metal film and the cuprous oxide. I would have preferred to say nothing about the matter until further work had been done towards its elucidation, but as the peculiarities of rectifying cells are apparently exciting a widespread interest, it may be as well to put these cases of reversal on record also.

J. GUILD.

The National Physical Laboratory,
Teddington, Middlesex.
Jan. 31.

Reaction Cells in Chain Reactions

THE simplest material chain reaction would be of the type $H + H_2(\text{para}) = H_2(\text{ortho}) + H$, though no evidence has yet been brought forward for its existence. An energy chain would be one in which an excited molecule took the place of the hydrogen atom.

We may define the chain-length by the number of fruitful collisions made by a chain carrier between its production and disappearance, regardless of the total number of collisions. If we consider a mixture of h molecules of the reactant H_2, and a molecules of chain stoppers (for example, an aerosol of antiknock), the average chain-length L is given by the simple probability expression

$$L = \sum_{r=1}^{r=\infty} r \left(\frac{h}{a+h}\right)^r \left(\frac{a}{a+h}\right) \Big/ \Sigma \left(\frac{h}{a+h}\right)^r \left(\frac{a}{a+h}\right),$$

provided that the pressure is so low that the probability of collision of any two molecules is practically independent of their instantaneous position in the vessel considered.

As the pressure is raised, the movements of all the molecules are hindered by the increasing resistance to diffusion; the probability of collision with distant molecules is smaller, and with nearby molecules greater. In particular, for reactions where the average chain-length is large, collisions with the reaction products left in the path of a chain carrier will be relatively more numerous at higher pressures. This may greatly affect the average chain-length.

If D is the coefficient of diffusion of the gas, the mean square displacement of the carrier is given by $\overline{x^2} + \overline{y^2} + \overline{z^2} = 6Dt$, where t is the time elapsed since the chain began. It is thus impossible for the carrier to react with molecules originally outside a cell of radius $2(6Dt)^{\frac{1}{2}}$. If $1/Y$ is the collision frequency, λ the mean free path and d the density, η the viscosity, $D = \frac{1}{3}\lambda\bar{c}$ and $Y = \frac{\lambda}{\bar{c}}$ where $\bar{c}$ is the R.M.S. velocity. After r collisions of any kind whatsoever, $t = rY$ and the radius of the reaction cell is $\lambda(8r)^{\frac{1}{2}}$ and its volume $(8)^{3/2}\frac{4\pi}{3}\lambda^3 r^{3/2}$. Since $\lambda d = \frac{3\eta}{\bar{c}}$ the number of molecules in the cell is proportional to $d \times \frac{r^{3/2}}{d^3} = \frac{r^{3/2}}{d^2}$, which decreases rapidly with increasing density.

The chain carrier has a greater probability of repeated collisions with molecules near the centre of its cell, but the analysis is too long to give here. It follows, however, that if the reaction products, or even impurities, deactivate the chain carrier, or if this has a probability of spontaneous radiation, that the average chain-length will decrease as the pressure rises. The number of chains initiated per second will not in general increase sufficiently with rising pressure to compensate for the decrease in length, and we may expect the rate of such reactions to decrease with rising pressure.

It is tentatively suggested that the upper pressure limit to explosions, discovered in a number of reactions by Hinshelwood and others, may find an explanation in the facts discussed here. It must be noted, however, that in this case we should expect vigorous stirring to increase the average chain-length, and possibly to shift the upper limit to higher pressures. No evidence is yet available on this point.

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Oxford.
Jan. 28.

Dissociation of Acetic Acid in Water

IN the measurements of MacInnes and Shedlovsky[1] and Jeffery and Vogel[2] on the conductivity of acetic acid and its salts in water, which have recently been the subject of correspondence in these columns[3], the most noticeable divergence is in the values for dilute solutions of sodium acetate. Jeffery and Vogel find that their values, after deducting the conductivity of the solvent, are lower than those of MacInnes and Shedlovsky, and that a correction for hydrolysis according to the equation $Ac' + H_2O \rightleftharpoons HAc + OH'$ reduces their figures still further, which leads them to the view that MacInnes and Shedlovsky's values are in error. The reason for this discrepancy is that in Jeffery and Vogel's experiments the hydrogen with which the acetate ion unites comes not from the water but from the carbonic acid present in it. The proper solvent correction for the salt of a weak acid has been discussed elsewhere[4] and can be calculated if the amount of carbon dioxide dissolved in the water is known. Applying it to Jeffery and Vogel's figures on the assumption that their water was saturated with carbon dioxide at a partial pressure of 0·00035 atm. gives values far *greater* than those of MacInnes and Shedlovsky, but the figures obtained in this way are undoubtedly too high, since Jeffery and Vogel's water (like that of the American workers) probably contained saline impurities as well as carbon dioxide. Without precise information on this point the correct extrapolation of Jeffery and Vogel's figures is impossible, but it can safely be concluded that the uncertainty fully covers the discrepancy of 1·6 units between the limiting conductivities derived in the two investigations.

It is to this discrepancy, together with a smaller one in the same direction between the values adopted for the mobility of the hydrogen ion, that the differing values reported for the dissociation constant of acetic acid are mainly due; if both series of measurements are compared on a common basis, the same value of K_a is obtained. This is shown in Fig. 1, in which the logarithm of the constant, uncorrected for activity changes, is plotted against the square root of the ionic concentration, using for both series the common value $\Lambda_0 = 390·59$. The use of this common value neglects the small difference in cell constant bases, which Jeffery and Vogel regard as within the limits of accuracy that they claim for their measurements.

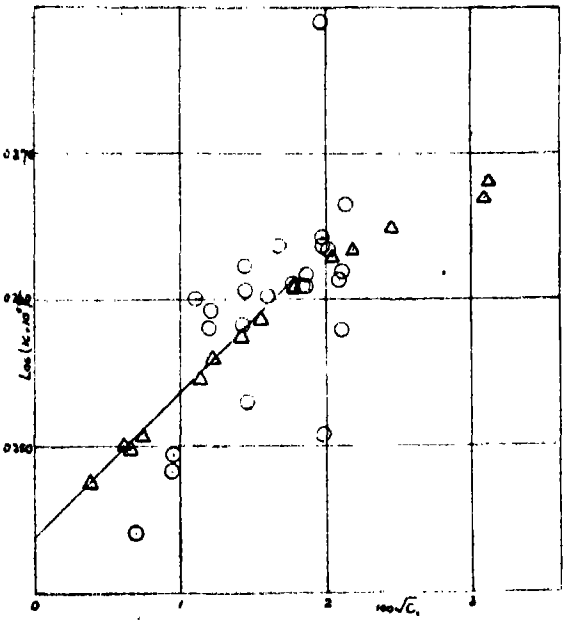

FIG. 1. Dissociation constant of acetic acid. ○, Jeffery and Vogel. △, MacInnes and Shedlovsky.

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W. H. BANKS.

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Jan. 17.

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[1] *J. Amer. Chem. Soc.*, 54, 1429; 1932.
[2] *J. Chem. Soc.*, 2829; 1932.
[3] NATURE, 130, 435, 774; 1932; 131, 27; 1933.
[4] *Trans. Faraday Soc.*, 28, 607; 1932.

Artificial Control of Sex in the Progeny of Mammals

GENETICS and cytology prove that the sex of the progeny of mammals depends upon the sex of the spermatozoon fertilising the ovum; the ovum itself is not determined as to sex. The 'female' spermatozoon possesses an X-chromosome, the 'male' possesses a Y-chromosome (or no sex chromosome at all), while every ovum has an X-chromosome. Male-determining and female-determining spermatozoa are mixed irregularly in the sperm. Therefore there is only one way of controlling the sex of progeny in mammals, namely, by separating the male-determining from the female-determining spermatozoa.

Spermatozoa with X- and with Y-chromosome are derived from one asymmetric mother $(X + Y)$ cell; it was accordingly natural to suppose that they would carry electrical charges of opposite sign. We accordingly tried to isolate them with an electric current. Most living cells during cataphoresis go to the anode, their surfaces being electrically negative. When we passed an electrical current through horse or rabbit sperm in physiological solution, we found that part of the spermatozoa went to the anode, part to the cathode, while the rest remained some time in the middle in the horizontal part of the Michaelis apparatus.

We have artificially impregnated three female rabbits with three portions of sperm after cataphoresis. The female impregnated with anode spermatozoa produced six young, all of the female sex; the second, impregnated with cathode spermatozoa, produced four males and one female; and the third, impregnated with the central fraction left between the two poles of the Michaelis apparatus, bore two males and two females. So far, this is the only experiment we have carried out on artificial impregnation with anode- and cathode-spermatozoa, and we propose to verify it on a larger scale. However, it is most improbable that the results were due only to chance. The only exception to what we expected, was a female born after fertilisation with cathode spermatozoa, which can be explained by the difficulty of obtaining complete isolation by mechanical means of three varieties of sperm in a Michaelis apparatus.

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Capacitance Hygroscopy

I AM obliged to Dr. Schofield for directing further attention to the subsidiary complications of capacitance measurements[1]. As E. B. Moullin says:[2] "We are again and again forced to remember that inductance, capacity, and resistance are attributes possessed simultaneously by all apparatus, and we cannot say that this is an inductance, or that is a capacity with the easy nonchalance of the power engineer". To avoid the accusation of such nonchalance, I used inverted commas for 'capacitance' in my article, made such cautionary remarks as the limits of space permitted, and used the word 'hygroscopy' instead of 'hygrometry' in its title.

Good demonstrations of these complications can be obtained by making various series and parallel connexions between web-tube condensers in air, and then again in water, noting the discrepancies.

It still remains true, however, that with the lay-out described in my article, and under the limitations of use which I there set out, the 'capacitances' which I measured are predominantly due to capacity. For example, the soil-water experiment which I presented was preceded by trials of such condensers in liquids of varied conductivity ; a typical set of readings was as follows :

Air	10	mμF.
Distilled water	44½	,,
Nitric acid, 0·001 per cent.	49	,,
,, 0·010 ,,	56	,,
,, 0·100 ,,	57½	,,
,, 1·000 ,,	59	,,

It follows that such changes in conductivity as are likely to be found in a soil might be expected to deflect the readings by some 5 mμF. at most, whereas the range shown in the actual soil-water experiment was around 50 mμF.

In his numerical examples, Dr. Schofield makes a slight mistake by calculating for resistances in series, whereas these are really in parallel, whether for the case of a web-tube or for a cotton-bale. Resistances of the order of 1,000 ohms in series would obviously dominate the situation, as he says. Actually the correct formula is :

$$\text{'Capacitance'} = \sqrt{C^2 + 1/w^2R^2},$$

and so long as R is not unduly small (for example, when the bale hoops are shorted by a saturated hessian covering) its variations are relatively not important.

In dealing with the physical properties of cotton we are on fairly well-known ground, and experiments on the changes in 'capacitance' of a perforated plate condenser containing cotton have been made similarly to those in which Slater[3] and Goshawk[4] measured the changes of conductivity and of dimensions under various moisture contents. The 'capacitance' changes are directly proportional in outline to the weight changes until very dry conditions are reached, less than 2 per cent of moisture content ; at this point the phase change first discovered by Slater is clearly seen, as if the dielectric constant of the water had there altered to less than half its usual value. But the region of practical working conditions for testing freshly pressed cotton bales (around 8½ per cent moisture content) is far above this, and is equally far below the occurrence of such low resistances in parallel as would seriously deflect the readings.

In these circumstances, Dr. Schofield will forgive me if I venture to disagree with his contention that there is nothing in my article to show that I was not mainly engaged in measuring resistances. The article would not have been published if that were so. Of course, the absence of explicit references therein to elementary trials which were made with non-inductive resistances in circuit, as well as test-alterations of frequency, may well have misled him into thinking that the work was even more amateurish than my apologia indicated it to be.

W. Lawrence Balls.

Cotton Research Board,
Giza, Cairo,
Egypt.
Feb. 1.

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[1] Nature, 131, 96, Jan. 21, 1933.

[2] Moullin, E. B., "Radio-Frequency Measurements", Griffin, 1931, in preface.

[3] Slater, F. P., *Proc. Roy. Soc.*, A., 1906. See also (4).

[4] In W. L. Balls, "Quality in Cotton", Chap. iii.

Is Plasticine Edible?

We were keeping some snails (*Helix pomatia*) without food, under a bell-jar with a wide tubulure at the top ; in the tubulure was a cork bearing a thermometer. We found that the snails ate the cork, so, to protect it, we covered it with a thick layer of red Harbutt's plasticine. To our surprise, the snails ate away a large amount of the plasticine, and produced fæces consisting of plasticine 'mouthfuls' loosely stuck together into irregular cylinders.

At the time of eating plasticine, the snails had been hibernating in a cold store for 18 months, after which they were brought into a warm room and made to emerge by immersion in water. They were therefore extremely hungry. In 24 hours a snail weighing 25 gm. ate 0·5 gm. of plasticine and produced the same amount as fæces. This is as if a 10-stone man were to eat 3 lb. of plasticine in a day.

We have heard many strange stories of substances eaten by hungry snails, but believe this to be the strangest.

D. I. Clements.
N. H. Howes.
G. P. Wells.

Department of Zoology,
University College,
London.
Feb. 14.

Hermaphrodite Frog

A frog with abnormal genitalia was brought to my notice during class work. A pad was present on the forefingers as in a normal male. The kidneys were longer than in a normal frog and reminiscent of those of the newt. The right testis was normal but the left had embedded in it very distinct ova. Vasa efferentia arose from both testes. The left oviduct was similar to that of a normal female but the right was thinner and only vaguely connected with the cloaca. The mesonephric ducts were normal but apparently lacked vesiculæ seminales.

The specimen, with others, was collected from a pond near Radley College, Abington, Berks, and it will be interesting to discover if others occur in this area.

A. A. M. Gardiner.

Radley College,
Berks.

Caution in Christening

The names of public characters should be chosen circumspectly. To christen the antiscorbutic agent (granted, that we at last have it in hand) *ascorbic acid* is to do it slight justice—even to rob it of the public appreciation it deserves. The name, in fact, is a scurvy one : neither has it obvious significance nor can it well be transposed into either French or German ; in no tongue will it have lilt.

Skorbut, whence scorbutic, apparently is of low German or Dutch origin. Why not call the spade a spade : simply, *antiscorbutic acid*—antiskorbutsäure—acide antiscorbutique ? I hope the distinguished magician who has so deftly conjured one of the great mysteries of our being into tangible form will accept the suggestion.

Henry E. Armstrong.

Research Items

Omaha Secret Societies. Dr. R. F. Fortune in a study of the Omaha and their secret societies (Columbia Univ. Contrib. Anthrop., vol. 14) supplements, expands and sometimes corrects the material of previous observers—in such matters, for example, as the hereditary character, at disposal in the male line, of membership of the different classes of Omaha society, of chieftainship (excepting the lesser chieftainships) and of membership in the secret societies. Consequentially it may be shown that Omaha society is essentially aristocratic under democratic forms. The Omaha have four important doctoring societies, each under its own special supernatural patron, each with its own individual mode of curing, and its own special group of disorders. The first society, however, is peculiar in having two supernatural patrons, the grizzly bear and the rattle-snake, each of which has its separate set of votaries dealing with its own group of disorders. The two sets of votaries, however, have their method of healing in common—extraction of the illness from the body of the patient by sucking. The grizzly bear votaries treat rheumatism and local body pains, except stomach trouble, which is the province of the rattle-snake votaries, this disorder being supposed to be due to rattle-snake poison in the stomach which has been wafted through the air by 'influence'. The second society is the ghost society, of which the patrons are the human ghosts. They treat delirium, epilepsy and mental disorders, their method of healing being the sprinkling of warm water. The third society is that of the buffalo patron, which heals wounds only by blowing water from the mouth over the part affected. The fourth society, which has a water monster patron, treats any ailment not pre-empted by the other three, as well as specialities, such as child-birth. This society works by sleight of hand, removing material objects from the part in which the disease resides.

Eyes and Colour Change. At the December meeting of the American Society of Zoologists, Prof. Lloyd M. Bertholf read a paper in which he described the influence of eye extract upon body colours (Science Service, Washington, D.C.) He found that eyes acted as glands, secreting a substance which caused contraction of chromatophores. The hormone was found in the eye-stalks of Crustacea, but it was effective in producing colour changes when injected into the body not only of Crustacea but also of frog tadpoles and of several species of fishes.

Bird Migration in Tropical Africa. Little has been written about the regular movements of birds in the tropics of the Old World, so that the account of migration by James P. Chapin in his great work on "The Birds of the Belgian Congo" is of unusual interest (*Bull. Amer. Mus. Nat. Hist.*, 65, 1932). There are regions in Africa where bird life shows little change throughout the seasons, but the moist Congo basin lies between two wide drier areas of Africa from which the birds have good reason to move in the unfavourable season. The migrants from such African areas enter the Congo by the northern and the southern borders ; some even come from Madagascar. But the migrations are complicated by the arrival of many individuals from Europe and Asia which seek refuge from the northern winter, and by a certain number of native water birds which vary locally in abundance according to the level of the great rivers. In addition, there are birds of passage from Europe and Asia which tend to pass through the Congo to South Africa. There the conditions appear to be so favourable to some northern species that they have been found breeding in South Africa, and the presence of distinct geographical races of Eurasian birds points to a suitability of habitat which has led to the establishment of migrating individuals in earlier times.

Functions of Radiation in the Physiology of Plants. Under the above title, two papers (*Smith. Misc. Coll.*, vol. 87, Nos. 13 and 14) describe recent work from the Division of Radiation, Smithsonian Institution. A more than usually elaborate apparatus for growth of plants under controlled conditions with special attention to radiation is described in detail (F. S. Brackett and E. S. Johnstone, No. 13). Temperature, humidity, gas concentration and pressure and aeration of nutrient solution, are fully controlled. Either lateral or overhead illumination may be obtained at will. Standard incandescent filament lamps used in conjunction with various filters, or electric discharges through gases may be used as sources of radiation. The latter method provides sources of monochromatic radiation otherwise difficult to obtain. Using the technique described, an examination of the effects of infra-red radiation upon tomato plants has been made (E. S. Johnstone, No. 14).

Improvement of Colour of Apples. A method of improving the colour of dessert apples after picking, by means of a process termed 'sun-dewing', is described by H. Goude in the *Journal of the Ministry of Agriculture*, vol. 39, p. 904. The process, which has been practised for many years at the Burlingham Horticultural Station, is very simple, entails no expensive apparatus and, at the same time, adds greatly to the commercial value of the fruit. The maximum cost may be roughly estimated as 1*s.* per cwt. Cox's Orange Pippin, Ellison's Orange, Allington Pippin and Laxton's Superb are some of the varieties mentioned which have been treated successfully, but apples with a greasy skin do not respond and others, such as Worcester Pearmain and Norfolk Royal, are apt to develop a bleached appearance. The fruit, eyes upward, is packed on trays lined with clean wood wool or moss and placed in an exposed position preferably facing south, but protected from birds, slugs, etc. Water is then sprayed over the fruit, which must not be allowed to become dry at any time during the treatment or shrivelling will set in. Exposure at night forms part of the treatment; although damage from frost has never been experienced, if frost occurs it should be washed off the fruit before the sun's rays reach it. Colouring will probably be effected after ten days, and the resulting fruit can then be stored in the usual way. The keeping quality of 'sun-dewed' apples is improved, and further, they show a pronounced resistance to store-rot troubles.

Submarine Valleys. Submarine valleys are known on many continental shelves and the use of echo sounding has facilitated their accurate charting. Prof. F. P. Shepard discusses their origin in a paper in the

Geographical Review for January. Such valleys have been variously attributed to river-cutting with displacements of the continental borders, to faulting, to submarine currents or to collapse of submarine solution channels. Prof. Shepard suggests that the chief cause has been originally river action followed by submergence in the long past, after which the valleys have been filled in by sediment during the cutting of the present continental shelves and then reopened from time to time by submarine landslides of the accumulated deposits. This theory provides an explanation of the fact that several of the valleys do not penetrate to the coasts as submarine estuaries. The landward part of the valley would be less liable to landslides than the steeper seaward end; or furthermore, the landward end would be liable to disappear, as a valley, in the cutting out of the continental shelf. Valley-free shelves occur in those areas where landslides have not occurred owing either to the slope being too gentle or to rapid cementation in calcareous sediments.

Particle Size and X-ray Spectroscopy. In a limited number of elements a lower intensity of the $L\alpha$ doublet has been observed when the element was in the form of metallic powder rather than a polished plate or even an oxide, and the effect is present to a very much less extent with K-radiation. Fonda (*J. Amer. Chem. Soc.*, Jan.) shows that the effect occurs under the usual experimental conditions, when the emitted X-ray beam is examined at a different angle from that made by the exciting beam of electrons. These irregularities, which may introduce serious errors in applications of X-ray spectroscopy to quantitative analysis, are a consequence of too large particle size, which brings about an abnormal absorption of the emitted radiation, particularly when it is in the longer wave-length range. X-radiation is excited throughout a certain depth of material, depending on the penetration of the electrons, and consequently encounters, in emission, a corresponding amount of absorption by the material itself. If there are any irregular protrusions in the surface which lie in the path of the beam under investigation, then the radiation is subjected to additional absorption as it passes through them. The decrease of intensity was found to be proportional to the magnitude of the surface irregularities in the target and to the coefficient of absorption of the target material. Attention must, therefore, be paid to the fineness of the powdered samples, particularly when $L\alpha$-radiation is used.

A New Temperature Recorder. Dr. W. Cawood and Mr. H. S. Patterson, of the Department of Inorganic Chemistry of the University of Leeds, have designed, and Messrs. Reynolds and Branson Ltd., Leeds, have put on the market, an accurate temperature recorder possessing many advantages over existing types. It consists of a special mercury thermometer, an image of which is projected on to a strip of bromide paper rotated either by clockwork or by a synchronous electric motor. The drum carrying the bromide paper is mounted in a light-tight case which can easily be detached and taken to the dark room for development. Each strip is 24 in. long, corresponding to 24 hours running, and by means of spare drums a continuous record may be obtained. The main advantage of the instrument over others of a like design is that both the top edge of the mercury meniscus and the engraved divisions on the thermometer are photographed simultaneously. The divisions of the thermometer appear as parallel lines which are cut off by the top of the mercury thread. Thus the only calibration required is that of the thermometer, and moreover, any vibration or jolt will not throw the instrument out of adjustment, but will merely displace the image. The accuracy and range depends upon the thermometer which is used; 0·01° may be easily obtained over a range of 3° or 4° C., or 0·1° over a range of 30° or 40° C., but this range can be enlarged by a simple modification of the apparatus. It will be appreciated that an accuracy of 0·01° is difficult to attain on any other temperature recorder and involves the use of apparatus both complicated and costly.

Astronomical Topics

The Sothic Cycle. Mrs. A. S. D. Maunder has published a paper on this subject (*J. Brit. Astro. Assoc.*, Jan.). The paper was written in answer to M. Sundaram Ayyar, who asserted the identity of the Egyptian Sothis with Arcturus, called Svati in India. It examines the sources of early Indian astronomy, and conjectures that the traditional author of the Siddhantas, Ashura Maya, may be a corruption of the Persian deity Ahura Mazda, and that these astronomical tables came from Persia. Mrs. Maunder gives a high valuation of the accuracy of the early observations made in Persia, but a much lower one to contemporary observations in Egypt, considering that the Egyptians could not then have observed the culmination of Arcturus with any accuracy. The well-known fact that the Nile flood comes close to the heliacal rising of Sirius leads her to adhere to the traditional view that Sothis is Sirius.

Direct Observation of Solar Prominences. The observation of solar prominences has hitherto only been possible by the aid of spectroscopes with widened slits, or of spectroheliographs, except during moments of actual totality in solar eclipses. In 1931, however, at the Pic du Midi, M. B. Lyot succeeded in making direct observations of prominences without such aids, owing to the extreme clearness of the atmosphere which eliminated much of the diffused sky light in the neighbourhood of the sun. On clear days, the intensity of this light was only 5 millionths that of direct sunlight, and prominences could be both seen and photographed even without the aid of a colour filter. The use of a simple red glass filter enabled them to be seen with ease even on poorer days. M. Lyot has repeated these experiments at Meudon, and described the results recently (*C. R. Acad. Sci.*, Nov. 21, 1932). Owing to the poorer atmosphere of Paris, a different form of filter was required. The author has devised one consisting of a tube filled with a slightly acidified solution of neodymium nitrate and closed at one end with Schott *RG*2 glass (the other end being of plain glass). In addition to some unimportant light in the infra-red, this filter transmits light in a narrow band (about 80 A.) containing the $H\alpha$ line. With its aid he has been able to photograph prominences at Meudon even on misty days, with an exposure of only one second for a solar image of 8 cm. diameter.

Relation of Food to Disease*

MANY diseases, ranging from different types of poisoning to deficiency diseases, are caused by defects or impurities in the food supply of a population: at times they may even occur in epidemics. Cure may be brought about by changing the food supply or by adding a missing factor to the diet; in other cases, only medical treatment is of value. Prevention, as always, is better than cure. With an adequate dietary of pure foods, most of these diseases can be abolished or their incidence greatly reduced. A review of the disorders associated with the ingestion of food, which was given by Mr. S. Dixon, the public analyst of the City of Cardiff, to a joint meeting of the South Wales Section of the Institute of Chemistry and the local section of the Society of Chemical Industry, at Cardiff, in February 1932, has now been issued as a small brochure and provides a useful and interesting summary of our knowledge of the subject.

The deficiency diseases are first briefly referred to, especially those associated with a deficient intake of one or other of the vitamins, such as rickets and scurvy, or in other countries beriberi and pellagra. Chemical poisons of non-bacterial origin may be inorganic substances which have gained access to the food through faulty methods of manufacture, or organic compounds present in certain animals or plants which are not foods in the true sense but may be consumed through inadvertence. Mushroom poisoning still occurs, although epidemic ergotism is now rare. An epidemic of the latter, however, occurred in England five years ago among Jewish immigrants from Central Europe who lived on rye bread.

The chief metallic poison which may contaminate foodstuffs is arsenic, which may find its way into the food through the use of material prepared with the aid of impure sulphuric acid: it may also be found on fruit which has been sprayed with an insecticide containing lead arsenite and once was inadvertently used as a dusting powder for boiled sweets. Antimony, lead and zinc may also produce poisoning, but small quantities of tin and copper do not usually have any deleterious effects.

Various diseases are conveyed to human beings by food which contains pathogenic bacteria. Milk may be responsible for the spread of typhoid, scarlet fever, diphtheria, bacillary dysentery, tonsillitis, and undulant fever. Surgical tuberculosis in children, when caused by bovine tubercle bacilli, is due to the ingestion of these organisms in the milk. Other articles of food which may be infected with the organisms of infectious diseases are ice-cream, meat, and shell-fish, especially mussels and oysters. Another group of diseases is due to contamination of the food with organisms of the *Salmonella* group, dysentery bacilli or *B. botulinus*. These are classified under the term, "Bacterial Food Poisoning". It is not considered that 'ptomaine' poisoning has any scientific basis, although two types of poisoning are due to toxins formed by organisms, namely, botulism, and a rare form of mussel poisoning which appears to be due to chemical poisons elaborated in the shell-fish by the vital activity of bacteria derived from sewage-contaminated surroundings.

Animal parasites are not responsible for much disease in Great Britain, though they assume greater importance in the tropics and in countries where food is imperfectly cooked. Tapeworm infestations, in their larval or adult forms, and trichinosis, from the ingestion of infested pork, are the commonest.

In conclusion, attention may be directed to food idiosyncrasy, which illustrates in the modern manner that what is one man's food may be another man's poison.

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* "The Relation of Food to Disease". By Stanley Dixon. Pp. 38. (London: The Institute of Chemistry of Great Britain and Ireland, 1932.)

Chemistry of Australian Timbers*

MESSRS. W. E. COHEN, A. L. Baldock and A. G. Charles have produced a useful pamphlet on the chemical composition of the woods of the ironbark group of eucalypts, which constitutes Technical Paper No. 4 of the Division of Forest Products of the Council of Scientific and Industrial Research. The important species upon which the study was based are the ironbarks *Eucalyptus sideroxylon*, *siderophloia*, *crebra* and *paniculata* together with a less important species *E. fergusoni* and the grey gums *E. propinqua* and *E. punctata*.

The first four mentioned are the commercially important ironbarks and have a wide geographical distribution, the group spreading over the eastern States, Queensland, New South Wales and Victoria; the remaining species have a more restricted distribution. The eucalypts are in great demand for all types of heavy structural works. They are used in railway and bridge construction, shipbuilding, coach and waggon building, houses, railway sleepers, wharf decking and so forth.

In a foreword to the pamphlet, Dr. Boas, chief of the Division of Forest Products, states that in this paper the authors describe the first extended chemical study of a group of timbers of the genus *Eucalyptus*. The importance now being attached to this chemical study of wood is summarised as follows: "There is a general trend in forest products research towards utilising wood substances after some form of chemical transformation. Other investigations involve altering the physical characteristics of wood to increase its resistance to fire, and to reduce in seasoned timber the absorption and loss of moisture with consequent shrinkage and swelling. Such proposals and those associated with converting wood into paper, artificial silk, lacquers, etc., must have their foundation in a fuller knowledge of the chemistry of timber. This Division has consequently planned work in this field, almost untouched as far as Australian timbers are concerned."

At present, in the systematic study of the chemistry of the timbers, consideration is being given to those groups containing woods, which, in addition to being very similar in general characteristics and therefore easily confused, are not easy to separate by means of their anatomical features. The object of the investigation discussed in the pamphlet, which was commenced in July 1930, was to obtain data on the proximate composition of sound, mature, true wood from authentic samples of the timbers with the view of studying (1) their general composition; (2) the possibility of constancy of chemical factors within a species, and of regular differences between species, so that these factors might be used in the identification of the timbers; (3) the variation of chemical composition within a tree; and (4) the applicability to Australian timbers of existing standard methods of wood analysis.

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* Commonwealth of Australia: Council of Scientific and Industrial Research. Pamphlet No. 32, Part 2. (Melbourne: H. J. Green, 1932.)

Some striking differences in chemical composition have been revealed between the eucalypts examined and the hardwoods of North America for which analyses are recorded. The eucalypts may be said to be characterised by the presence in their vessels, rays, and fibres of gum-like, brittle, extraneous substances which are not soluble in the usual organic solvents, but are readily soluble in alkaline solutions. The eucalypts possess definitely lower contents of cellulose and total pentosans than North American hardwoods do, even though due consideration is made for differences in extractives. It is interesting to note that the lignin content is much the same for both series in spite of the different analytical methods used, and, if it is assumed that the apparent lignin content of the North American woods will be decreased by initial treatment with $N/8$ sodium hydroxide, then the figures will probably be nearly the same.

The present study has revealed the fact that the standard methods for wood analysis employed in other countries are not readily applicable to the eucalypts. Here again the extraneous substances have played an important part. Their brittle nature has served to indicate that the so-called standard method of sampling wood in the form of sawdust, powder, etc., is inaccurate. Their insoluble nature and resistance to acid hydrolysis have resulted in the failure of the usual method for indicating the correct lignin content of woods. Consequently, the methods of analysis have had to be considerably modified, and it would appear that these modifications are applicable to wood analysis in general.

Developments in Highway Research

PROF. STEINBURG of University of Maryland gave a radio talk on January 13 under the auspices of Science Service over the Columbia broadcasting system on developments in highway engineering. Of the many problems confronting the engineer, the one in which the public is most interested is that of safety in the streets. In the United States there is a rapidly increasing motor-car annual toll of about 34,000 lives and a million injuries.

Although primarily an engineering problem, highway safety is very considerably affected by the psychological, as well as the physical, demands upon the driver of a motor-vehicle. Recent research has shown that the human factor is responsible for approximately ninety per cent of motor-vehicle accidents in the United States and that the causes attributed to defects in the highway or the vehicle are of small relative importance. A psychological study was recently made at the Iowa State College of 2,000 drivers. They were tested on a specially constructed outside road as to their action and reaction when lights, signals, direction and warning signs were encountered. The results showed that the drivers could be divided into three classes. The first class consists of the 'accident free' drivers and comprises about seventy-five per cent of those tested. This group causes little trouble in any ordinary circumstances. The second group numbers about twenty per cent of the total and contains the 'accident liable' drivers who give trouble from various causes. Some are irresponsible, some are preoccupied through illness or personal affairs, while others are careless. Their failure arises either from heredity or environment and renders it necessary for the highway engineer to provide fool-proof roads. The third small group and the individuals who compose it generally suffer from some defect such as colour blindness, restricted field of vision, double vision of a single object, or extreme nervousness and poor co-ordination. Now as half the total accidents are caused by only about seven per cent of all drivers, it is obvious that special consideration has to be given to this third class.

A recent study of road signal signs shows that in the central west of the United States they are well standardised as to form, size, colour and location, while in the east there is much diversity of practice. Delaware has recently experimented with a pictographic signpost showing the direction of the roads on the marker by drawings similar to those used in Canada. They were found much clearer and more easily understood than the type in general use. Experiments have shown that arrow pointers are superior to the marks *R* and *L* for indicating right and left, as many people are momentarily nonplussed when told to go to the right or to the left; and it has been found that for road markers, canary yellow is much the best colour, as it stands out well from surrounding objects at all seasons of the year, and, as the human eye is very sensitive to yellow light, it is good for low illuminations.

Experiments were quoted showing that the capacity of a two-lane road is 1,000 vehicles per hour, for a three-lane road it is 2,000 and for a four-lane 3,000 vehicles and that the risk of accident is greatest with the three-lane road. This research in highway engineering has been a valuable one and has led to many practical changes which will result in a very large saving of both highway funds and vehicle operating costs.

Nomenclature of British Marine Mollusca*

IN revising the "List of British Marine Mollusca" for his presidential address to the Conchological Society, Mr. R. Winckworth has, admittedly, attempted a difficult task which is bound to bring forth criticism. A new list was certainly wanted, for it is more than thirty years since a special committee of the Conchological Society published one (*J. Conchol.*, 10, No. 1. Jan., 1901) which is now in many ways out of date. All workers on the group will be grateful for this well-authenticated revision, compiled by one who is an authority on the subject.

The greatest difficulty which one meets in deciding correct nomenclature is not now so much the weight of old literature which has to be perused in order to ascertain which authority has priority, heavy as this burden is, but the keeping up to date with new work constantly appearing which brings forward new facts necessitating alterations. Thus every day new data turn up, old names must be abandoned and new relationships admitted.

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* "The British Marine Mollusca", by R. Winckworth. *Journal of Conchology*, 19, No. 7, June 1932 (Presidential Address, Oct. 1931).

One of the obstacles to be met in making a natural classification is the absence of detailed knowledge of the life-histories of the various molluscs. A thorough acquaintance with the eggs and larvæ at all stages would do away with much that is obscure. Mr. Winckworth in his preliminary remarks refers to work lately begun at the Marine Biological Laboratory, Plymouth, which is an attempt to supply this want. Already it is proving useful in determining the natural relationships of gastropods.

Another serious disadvantage is the inability of workers in general to see a large enough series of shells. Work such as has lately been published by Mr. John Colman ("A Statistical Test of the Species Concept in Littorina". *Biological Bulletin*, 42. No. 3. June, 1932) is valuable.

In 1931 the Marine Biological Association published a second edition of the "Plymouth Marine Fauna" in which the nomenclature of the Lamellibranchiata and to a less extent the Gastropoda were revised by Mr. Winckworth. In his new list, however, quite a number of the names (family, genus and species) have been changed; for example, *Erato lævis* altered to *Erato voluta* on account of a few months priority of Montagu over Donovan: *Psammosolen candidus* (Renier) altered to *Solecurtus scopula* (Turton) and many others. This is a good example of the difficulties encountered in undertaking such an arduous piece of work.

The "List of British Marine Mollusca" can be purchased from the Secretary of the Conchological Society of Great Britain and Ireland, Manchester Museum, The University, Manchester, or from Messrs. Dulau and Co., Ltd., 32 Old Bond Street, London, W.1, price 9*d*.

The Iron and Steel Industry

THE last of the present series of lectures on industrial affairs at the Imperial College of Science and Technology was delivered on February 23 by Sir William Larke who took as his subject "The Iron and Steel Industry". He pointed out that although the smelting of iron ore with charcoal has been carried on since 2500 B.C. or even earlier, smelting with coal or coke was not established successfully until 1730–35. Between 1740 and 1840 the production of pig iron in Great Britain rose from 17,350 tons to 1½ million tons, but it was not until about 1860 that the 'iron age' gave place to the 'steel age'. This change was signalised by the rapid development of railways and by the substitution of steel for iron in shipbuilding. As the birthplace of the iron and steel industries and of the blast furnace, the steel furnace and the rolling mill, Great Britain was for many years the leading producer, but owing to intensive developments in other countries, especially the United States and Germany, it had fallen to third place in respect of pig iron production by 1913.

After the War, the important iron ores of Lorraine came under French control, and when Germany recovered her economic freedom in 1925 the products of this district were thrown upon the world markets. In the meantime, other countries were building up iron and steel industries and Great Britain was practically the only accessible free market for the huge surplus Continental production. It is noteworthy, however, that if the world consumption of pig iron had continued to increase at the average rate of 6 per cent a year which was maintained between 1810 and 1910, it would have reached 186 million tons in 1932: the actual production in that year was only 38 million tons and the productive capacity 120 million tons.

Sir William Larke believes that we are suffering to-day from under-consumption rather than from over-production. The organisation of the German iron and steel industry on a national basis was followed by the formation of a Continental steel cartel, but with contraction in demand, prices could not be maintained and fell eventually below the cost of production. The cartel ceased to function in 1930. The British market was the cockpit in which the price warfare was waged: after the introduction of protection Continental producers were endeavouring to maintain their sales at prices as much as 40 per cent less than the cost of production.

It might be supposed that the fall in prices of iron and steel would react to the advantage of those industries which use these commodities as their raw materials. Under pre-War conditions, when the general demand for goods was expanding rapidly, this would have been true, but it must be realised that these conditions no longer prevail. Undertakings involving the large-scale consumption of steel, for example, shipbuilding, are actually held back lest a further fall in price should render the enterprise uneconomic at the new level. In fact the present economic situation is probably unique in the history of mankind, and the solution of its problems cannot be found on pre-War lines. In Great Britain steps have been taken and are being taken towards the establishment of a strong national organisation of the iron and steel industry. Unrestricted competition, which was formerly advantageous in promoting efficiency and stimulating enterprise, now requires to be strictly limited. Since what we call the iron and steel industries really consist of about a dozen related industries, there are many conflicting interests to be reconciled; but much has already been done in the establishment of co-operation not only at home, but also at Ottawa with the Dominions.

The next step is international co-operation to regulate production in relation to demand and to stimulate consumption. So long as the British market was open, little could be done in this direction. The adoption of a protectionist policy has, however, brought about conditions favourable for negotiations with foreign producers, and our co-operation is now being actively sought. In fact, at the beginning of this month an agreement was signed for a new cartel, which is to deal with export trade only. This cartel will be maintained only if sales agreements can be made and a stabilisation of price levels achieved.

In conclusion, Sir William Larke referred to the prospects for scientifically trained men in industry.

In the iron and steel industry there is scope for chemists, physicists, metallurgists and engineers—provided that they have the gift of establishing human relations. In industry, the understanding of one's fellow men is more important than technical knowledge. Sir William decried the modern pose that enthusiasm is 'bad form'. We live in an age of great difficulties and responsibilities, but also of great possibilities—and we need all the enthusiasm that we can muster.

Flora of East Anglia

"THE East Anglian Flora—a Study in Comparative Plant Geography" is the title of the presidential address by Prof. E. J. Salisbury to the Norfolk and Norwich Naturalists' Society, reprinted from the Society's *Transactions* (vol. 13, pt. 3, 1932, pp. 191–263).

While treating specially of the flora of East Anglia, Prof. Salisbury has extended the scope of his address to include a survey of the major problems of geographical distribution in Great Britain as a whole. Eight components are recognised in the British flora, four of which are further subdivided into eleven constituent elements, and stress is laid upon the importance of viewing these groups in relation to the distribution of the species on the continent of Europe. The largest components are the southern, the oceanic and the continental. The majority of the southern species exhibit in Britain a diagonal limit running in the south-west—north-east direction, indicative of their comparative intolerance of oceanic conditions, while in contrast to these, most of the oceanic species show a diagonal limit passing in a south-east—north-west direction. The continental component includes the steppe species, many of which are located in East Anglia, and it is held that their occurrence there is correlated with a combination of low rainfall and favourable edaphic conditions.

Two strikingly contrasted climatic areas are found in the East Anglian region, in which marked difference in rainfall is accentuated by differences of soil and topography, resulting in the juxtaposition of both continental and oceanic species. The general conclusion is reached that climate is the most important factor determining the distribution of plants in Britain, though evidence is adduced in certain cases to show that soil preferences and the competition factor may act as modifying influences.

A noteworthy feature of the paper is the large number of maps, 106 in all, clearly illustrating the range of individual species within the British Isles, while numerous photographs are included depicting certain interesting species in their natural habitats. Copies of the paper (price 5*s.*) may be obtained from Dr. S. H. Long, 31, Surrey Street, Norwich.

University and Educational Intelligence

BIRMINGHAM.—The annual meeting of the Court of Governors on February 23 presided over by the Chancellor (Viscount Cecil of Chelwood) was marked by a general feeling of regret at the retirement from the Council of Mrs. C. G. Beale (widow of the first Vice-Chancellor) and the resignation of his office as Pro-Chancellor by Sir Gilbert Barling after many years of highly valued service to the University. Mr. Walter Barrow was elected Pro-Chancellor and, after the Chancellor had signified his approval of the election, Sir Gilbert Barling rose from his seat and divested himself of his robes of office saying that these robes, originally worn by the first Vice-Chancellor, had been given to him by Mrs. Beale when he succeeded to the vice-chancellorship. Sir Gilbert now desired, with Mrs. Beale's approval, to present them to the University and he proceeded forthwith to invest with them the new Pro-Chancellor. The Chancellor paid a tribute to Sir Gilbert Barling, whom he described as a man possessed of a great faculty which he could only describe as the faculty of being right. His advice was always to be trusted.

Sir George Kenrick moved a resolution in which the Court gratefully acknowledged the services of the retiring Pro-Chancellor as demonstrator in anatomy in Queen's College in 1885, as professor of pathology in 1886–1893, joint professor of surgery in 1893–1913, dean of the Faculty of Medicine in 1905–1912, member of the Court of Governors since 1900 and of the University Council since 1903, as Vice-Chancellor and chairman of Council in 1913–1927 and Pro-Chancellor from 1927 until the present time. Prof. F. W. Burstall in seconding the resolution paid a tribute on behalf of the academic side of the University. The dean of the Faculty of Medicine (Dr. Stanley Barnes) spoke in very warm and appreciative terms of Sir Gilbert whom he characterised as a great surgeon, a great teacher and a great administrator.

The title of emeritus professor was conferred on Prof. W. S. Boulton (geology and mineralogy) and Prof. J. T. J. Morrison (forensic medicine and toxicology).

CAMBRIDGE.—A University demonstrator in geography will shortly be appointed. The duties will commence on April 1. Particulars can be obtained from Prof. F. Debenham, at the Department of Geography, to whom applications should be sent on or before March 7.

The Balfour studentship in biology has been awarded to F. R. Parrington of Sidney Sussex College.

It has been recommended that the plans prepared by Sir Herbert Baker for the Scott Polar Research Institute be approved.

EDINBURGH.—His Majesty the King in Council has approved of the ordinance providing for the affiliation of the Heriot-Watt College to the University.

Prof. Heinrich Wieland, of the University of Munich, has been invited to give the first Romanes lecture. These lectures are provided from an endowment fund in memory of Dr. Robert Romanes, and James Manners Romanes, brother of the late Miss I. D. Romanes. Part of the endowment is used to bring distinguished chemists from other centres to lecture in Edinburgh.

LONDON.—His Majesty the King, who will be accompanied by the Queen, will lay the foundation stone of the new University buildings on June 26.

The following appointments have recently been made: Prof. J. B. S. Haldane, since 1922 reader in biochemistry in the University of Cambridge and since 1927 head of the Genetical Department at the John Innes Horticultural Institution, to be professor of genetics at University College; Mr. W. P. Yetts, lecturer in Chinese art and archæology at the Courtauld Institute of Art, to be professor at the Institute; Prof. Cyril L. Burt, to the Heath Clark lectureship for 1933.

DUBOIS: The stratigraphic subdivision of the schistogreywacke complex of the Vosges. It is shown that, with or without the middle Devonian, the Visean and especially the lower Visean, holds an important stratigraphical place in the whole of the Vosges. MLLE. S. GILLET: An attempt at a classification of the upper Miocene and of the lower Pliocene of Rumania. The Dacic basin. PAUL FALLOT: Geological observations in the Djebel Kelti massif (Spanish Morocco). J. REPELIN: Observations on the tectonic of the western part of the Nerthe. RAYMOND CIRY: The lateral passage of the Cretaceous with so-called Wealdian facies of the province of Burges to the lower marine Cretaceous of the Cantabric provinces. D. SCHNEEGANS: The presence of the middle Jurassic (Dogger) in the sheet of Ubaye to the north of the valley of Barcelonnette (French Alps). MARCEL THORAL: The existence of the Georgian in the mountains of Lacaune. DAVID STENQUIST. The relation between the daily variations of the earth current and the terrestrial magnetic field. PH. FLAJOLET: The transparency of the atmosphere in the Lyons region. The visibility of the Alps. In a recent note, André Allix, discussing the observations of the visibility of the Alps made at the Observatory of Fourvière, concludes that there has been a progressive obscuring of the atmosphere near Lyons during the last thirty years. These results are now compared with observations at the Saint-Genis-Laval Observatory, made at the same altitude and about 8km. to the south. The two sets of observations are in general agreement, but, in the author's opinion, do not prove a progressive change in either direction. The visibility of the Alps does not appear to be capable of being influenced by the greater or less abundance of smoke. MLLE. MADELEINE FOURCROY: The indirect action of traumatisms on the evolution of the conducting apparatus (in plants). JACQUES MONOD: Demonstrating the axial gradient in the ciliated Infusoria by photolysis by means of the ultra-violet rays. The results entirely confirm those of Child: the ultra-violet rays exert a differential cytological action identical with that of chemical poisons. This shows that the differential susceptibility is not only a question of differences of permeability, but also expresses the fundamental physiological polarity of the cell. V. A. KOSTITZIN: Some quasi-periodic phenomena in closed basins. P. VLÈS: The correlations between the evolution of the weight of infants and the electrical properties manifested at their level. MME. Y. KHOUVINE and G. NITZBERG: The identification and biochemical oxidation of α-glucoheptulite. That α-glucoheptulite is not a mixture has been proved by X-ray photographs. Biochemical oxidation with *Acetobacter xylinum* gave α-glucoheptulose. R. WOLFF and MLLE. LAFRANCAISE: The action of pancreatic extract on glycocine in glycerol solution. J. LIGNIÈRES: The duration of immunity after vaccination against foot and mouth disease.

ROME

Royal National Academy of the Lincei. Communications received during the vacation, 1932. S. CHERUBINO: Classification of hyper-elliptic surfaces from the real point of view. The classification of these surfaces is completed in a manner that appears satisfactory and of useful application. Certain of the more simple and striking relationships between Scorza's nine types (1916) and Lefschetz's seven types (1919) are indicated. B. COLOMBO: An equation with partial derivatives of the fourth order. HANS HAMBURGER: Ribaucour's transformation and spherical representation (3): Ribaucour's cyclic systems. This theory of cyclic systems furnishes other applications of Ribaucour's transformation. On the basis of a deduction made by Bianchi, a formula is derived which determines all the cyclic systems normal to a given surface x (u, v). V. HLAVATÝ: Projective curves of a curve in the projective space P_{n-1} (n = or >3). D. MANGERON: A problem of the contour for a non-linear differential equation to the partial derivatives of the fourth order with double real characteristics. MARIA PASTORI: Properties of conjugated hemi-symmetric tensors. B. SEGRE: Algebraic surfaces having the canonical system combined with an involution. M. PASCAL: The motion of a deformable body which remains similar to itself. (2) Instantaneous centre of velocity and its consequences. F. ZAGAR: The variation of the eccentricity in the problem of two bodies of variable masses. Two particular integrable cases are considered. C. CANNATA: An extension of Woo's formula: intensity of the light diffused by an electron in motion. For the case when the diffusing electron is moving in the same direction as the incident pencil, Woo has calculated the intensity of the diffused radiation on the basis of classical theory. Woo's result is now confirmed by an analogous but simpler method, and is extended to the case when the electron is moving in any direction whatever. C. DEI: Circuits with a capacity in parallel on a diode in saturation. A. FERRARI and G. TRAMPETTI: Investigations on the behaviour of mixtures of zinc oxide and anhydrous zinc chloride at high temperature. The solubility of zinc oxide in fused zinc chloride does not exceed 5 per cent (molecular). The existence of anhydrous zinc oxychlorides appears improbable, the hydrated oxychlorides undergoing decomposition in the fused mixture. C. GUARESCHI: First results of the combined method: differential susceptibility and vital colours, in the development of Amphibia. T. PERRI: Transplantation experiments with Amphibia. G. AMANTEA and V. FAMIANI: Further considerations on the possibility of obtaining permanent beriberi phenomena by exclusion of the *B* factor. The results previously obtained with pigeons have now been confirmed by similar experiments on hens. V. FAMIANI: (1) The capacity for food consumption after fasting. When pigeons which have fasted until they have lost 20 per cent in weight are fed, they are at first able to take only very little food, but the amount taken gradually increases to about double the normal quantity, at which it persists until, or even after, the original body-weight has been resumed. (2) Reconstructive food value of the embryos of various cereal and leguminous seeds. These embryos are not only of greater value than other parts of the seeds in normal nutrition, but also they result in more rapid resumption of weight when administered to fasting pigeons. G. MEZZADROLI and A. AMATI: Action of certain alkaloids on the development of *Aspergillus niger*. Quinine and strychnine, in small concentrations, favour the growth of this mould, but caffeine exerts an inhibiting influence. A. SALVATORI: Contribution to the knowledge of the nature and value of Bezssonoff's reaction for the *C* factor. Bezssonoff's reagent is not specific for the *C* factor, but merely reveals the presence, in all antiscorbutic materials, of a reducing factor.

Forthcoming Events

Monday, March 6

VICTORIA INSTITUTE, at 4.30—(in Committee Room B, Central Hall, Westminster).—Dr. J. Burnett Rae: "Psychology and the Problem of Inadequacy" (Dr. A. T. Schofield Memorial Paper).

UNIVERSITY OF LEEDS, at 5.15.—Prof. A. C. Chibnall: "The Biochemistry of Plant Waxes".

ROYAL SOCIETY OF ARTS, at 8—(Cantor Lectures).—Arthur Stephenson: "Welding and Allied Processes for Engineering Purposes" (succeeding lectures on March 13 and 20).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Sir Douglas Mawson: "Kerguelen".

Thursday, March 9

CHEMICAL SOCIETY, at 7—(extra meeting at the University of Manchester).—Prof. E. K. Rideal: "How Chemical Reactions Go".

CHADWICK PUBLIC LECTURE, at 8—(at the Royal Sanitary Institute).—Dr. E. Killick Millard: "Housing".

Friday, March 10

ROYAL INSTITUTION, at 9.—Lord Rutherford: "Recent Researches on Transmutation of the Elements".

INSTITUTE OF METALS, March 8–9.—Annual General Meeting.

Official Publications Received

GREAT BRITAIN AND IRELAND

Ministry of Agriculture and Fisheries. Report of the Reorganisation Committee for Milk. (Economic Series No. 38.) Pp. 228+xx. (London: H.M. Stationery Office.) 6*d*. net.

Economic Advisory Council. Tsetse Fly Committee Report: Developments in the Treatment of Animal and Human Trypanosomiasis and in Tsetse Fly Control in the Period 1925–31. Pp. 27. (London: H.M. Stationery Office.) 6*d*. net.

Census of Nigeria, 1931. Vol. 1: Nigeria. By S. M. Jacob. Pp. viii+155. 10*s*. Vol. 2: Census of the Northern Provinces. By N. J. Brooke. Pp. ii+234. 12*s*. Vol. 3: Census of the Southern Provinces. By H. B. Cox. Pp. ii+46. 4*s*. Vol. 5: Medical Census, Northern Provinces. By Dr. R. C. Jones. Pp. ii+92. 7*s*. Vol. 6: Medical Census, Southern Provinces. By Dr. J. G. S. Turner. Pp. iv+101. 8*s*. (London: The Crown Agents for the Colonies.)

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 2, No. 19: Notes on the Kidston Collection of Fossil Plant Slides. No. 1: The Anatomy of the Axis of Lepidodendron Brownii Unger sp., with Special Reference to the Relationship between this Stem and Lepidostrobus Brownii Unger sp. By Mary G. Calder. Pp. 547–555+3 plates. 2*s*. 3*d*. Vol. 57, Part 2, No. 20: The Metamorphism of the Deeside Limestone, Aberdeenshire. By Dr. Arthur G. Hutchison. Pp. 557–592. 4*s*. 6*d*. Vol. 57, Part 2, No. 21: The Restoration and Regeneration of the Epithelium and Endometrium of the Uterus of *Cavia* Post Partum in Non-Pregnant Animals. By William J. Hamilton. Pp. 593–600+1 plate. 1*s*. 6*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Proceedings of the Royal Society of Edinburgh, Session 1932–1933. Vol. 53, Part 1, No. 4: On Properties of Null Geodesics, and their Application to the Theory of Radiation. By Dr. W. O. Kermack, Dr. W. H. M'Crea and Prof. E. T. Whittaker. Pp. 31–47. 1*s*. 6*d*. Vol. 53, Part 1, No. 5: Expansion and Contraction of Coal caused respectively by the Sorption and Discharge of Gas. By Prof. Henry Briggs and R. P. Sinha. Pp. 48–53. 9*d*. Vol. 53, Part 1, No. 6: On the Graduation of Data by the Orthogonal Polynomials of Least Squares. Pp. 54–78. 2*s*. 3*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

OTHER COUNTRIES

U.S. Department of Agriculture. Miscellaneous Publication No. 98: Market Diseases of Fruits and Vegetables—Potatoes. By Prof. George K. K. Link and Glen B. Ramsey. Pp. 63+15 plates. 30 cents. Miscellaneous Publication No. 121: Market Diseases of Fruits and Vegetables—Tomatoes, Peppers, Eggplants. By Glen B. Ramsey and Prof. George K. K. Link. Pp. 44+11 plates. 20 cents. (Washington, D.C.: Government Printing Office.)

Cornell University: Agricultural Experiment Station. Bulletin 541: Soils in relation to Fruit Growing in New York. Part 1: A Detailed Soil Survey of the Hilton Area, Monroe County. By A. T. Sweet and Joseph Oskamp. Pp. 16+1 map. Bulletin 542: Killing Perennial Weeds with Chlorates during Winter. By W. C. Muenscher. Pp. 8. Bulletin 549: An Analysis of the Loaning Operations of the Federal Land Bank of Springfield from its Organisation in March 1917 to May 31, 1929. By F. F. Hill. Pp. 107. (Ithaca, N.Y.)

Differences between certain of the North American Indian Tribes as shown by a Microscopical Study of their Head Hair. By George Woodbury and Edna T. Woodbury. Pp. 37. (Denver, Colo.: State Historical Society of Colorado.)

Bulletin of the Vanderbilt Marine Museum. Vol. 1, Art. 3: Scientific Results of the Yacht *Alva* World Cruise, July 1931 to March 1932, in Command of William K. Vanderbilt. Fishes. By N. A. Borodin. Pp. 65–101+2 plates. (Cambridge, Mass.)

Field and Laboratory: Contributions from the Science Departments of Southern Methodist University. Vol. 1, No. 1, November, 1932. Pp. 32. (Dallas, Texas.)

Bulletin of the Geological Society of America, Vol. 43. Gondwana Land Bridges, by Charles Schuchert; Isthmian Links, by Bailey Willis. Pp. 875–952+plates 24–29. (New York City.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 84. A New Species of Sailfish, *Istiophorus brookei*, from Tahiti. By Henry W. Fowler. Pp. 403–404+plate 20. (Philadelphia.)

Smithsonian Miscellaneous Collections. Vol. 87, No. 16: Carbon Dioxide Assimilation in a Higher Plant. By W. H. Hoover, Earl S. Johnston and F. S. Brackett. (Publication 3186.) Pp. 19+2 plates. Vol. 87, No. 17: Absolute Intensities in the Visible and Ultra-Violet Spectrum of a Quartz Mercury Arc. By E. D. McAlister. (Publication 3187.) Pp. 18. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 9, No. 6, December, Research Papers Nos. 501–511. Pp. 711–860. 25 cents. Vol. 10, No. 1, January, Research Papers Nos. 512–521. Pp. 149. 25 cents. (Washington, D.C.: Government Printing Office.)

The Felidæ of Rancho La Brea. By John C. Merriam and Chester Stock. (Publication No. 422.) Pp. xvi+231+43 plates. (Washington, D.C.: Carnegie Institution.)

Observatoire de Zi-ka-wei: Annales de Zô-Sè. Tome 17, Fasc. 5: Théorie approchée de la petite planète (113) Amalthea. By E. de la Villemarqué. Pp. D49. Tome 17, Fasc. 6: Observations photographiques d'Eros. Pp. E68. (Zi-ka-wei.)

Sveriges Geologiska Undersökning. Årsberättelse för År 1931. Pp. 12. (Stockholm: P. A. Norstedt and Söner.) 0.50 kr.

Trinidad and Tobago. Notes on the Production of Sugar Cane. Taken by S. M. Gilbert at the Fourth Triennial Conference of the International Society of Sugar Cane Technologists held at Puerto Rico in March, 1932. Pp. 35+3 plates. (Trinidad: Government Printing Office.) 2*s*.

Carnegie Institution of Washington. Year Book No. 31, July 1, 1931, to June 30, 1932: with Administrative Reports through December 9, 1932. Pp. xi+392. (Washington, D.C.: Carnegie Institution.)

Proceedings of the United States National Museum. Vol. 81, Art. 17: The Helminths parasitic in the Amphibia and Reptilia of Houston, Texas, and Vicinity. By Paul D. Harwood. (No. 2940.) Pp. 71+5 plates. (Washington, D.C.: Government Printing Office.)

Education, India. Occasional Reports No. 16: A Report on the Use of the Mother-tongue as the Medium of Instruction and Examination in certain Subjects for the Matriculation Examination of the Bombay University. By M. R. Paranjpe. Pp. vii+47. (Calcutta: Government of India Central Publication Branch.) 10 annas; 1*s*.

Memoirs of the Asiatic Society of Bengal. Vol. 9, No. 6: Geographic and Oceanographic Research in Indian Waters. Part 6: Temperature and Salinity of the Deeper Waters of the Bay of Bengal and Andaman Sea. By Lieut.-Col. R. B. Seymour Sewell. Pp. 357–424. 2.13 rupees. Vol. 11, No. 5: Algal Flora of the Chilka Lake. By Kalipada Biswas. Pp. 165–198+plates 25–32. 3.15 rupees. (Calcutta.)

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 26, 1930, No. 4. Pp. 419–588. (Calcutta.) 5.10 rupees.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 71: Investigations on Irrigated Pastures. 1: The Yield and Botanical Composition of an Irrigated Permanent Pasture under various Systems of Pasture Management, by Dr. A. E. V. Richardson; 2: The Chemical Composition of Irrigated Pastures at Wood's Point, South Australia, by H. P. C. Gallus. Pp. 45+7 plates. (Melbourne: H. J. Green.)

CATALOGUES

British Industries Fair, 1933: Birmingham Section, February 20th to March 3rd, 1933. Supplementary Guide to Electrical Exhibits: Plan and List of Exhibitors. Pp. 16. (London: The British Electrical Development Association, Inc.)

Newton's Epidiascopes: High Intensity Models fitted with Special Diffusion Reflectors. Pp. 6. (London: Newton and Co.)

Catalogue of Science and Technology, No. III. Annotated and Classified List of Rare and Standard Works on Exact and Applied Science. Part 10: XIII. 2, Civil Engineering. (No. 836.) Pp. 1017–1112. (London: Henry Sotheran, Ltd.)

The Notched Echelon Cell for Rapid Absorption Spectrophotometry in the Visual and Ultra-violet Regions. (Publication No. 178.) Pp. 11. The Spekker Ultra-Violet Spectrophotometer. (Publication No. 184.) Pp. 4. The Campbell Solution Calculator for rapidly calculating the Behaviour of Solutions. (Publication No. 177.) Pp. 4. (London: Adam Hilger, Ltd.)

Degussa Lilliput Gas-heated Laboratory Furnace for 600–1900° C. Pp. 4. Degussa-Lilliput Furnace for Metal Melting. Pp. 2. High Temperature Furnaces for Gas-heating up to 2000° C. Pp. 8. (London: Bush, Beach and Gent, Ltd.)

Watson's Microscope Record. No. 28, January. Pp. 24. (London: W. Watson and Sons, Ltd.)

Lettres, Arts, Sciences. Pp. 32. (Paris: Librairie Delagrave.)

Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Orient. (No. 23.) Pp. 119–168. (Paris: Libr. Adrien-Maisonneuve.)

Catalogue of Scientific Books and Publications of Learned Societies. (No. 404.) Pp. 84. (Cambridge: W. Heffer and Sons, Ltd.)

A List of two recently purchased Collections of Botanical Books. (No. 205.) Pp. 16. (London: Dulau and Co., Ltd.)

Wild-Barfield Forced Air Circulation Furnaces. Pp. 8. (London: Wild-Barfield Electric Furnaces, Ltd.)

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Power Alcohol

THE motor-car, of which there are so many millions, has provided a market as never before for a variety of manufactured products, and above all for the fuel used to drive its engine. It is responsible for the development of the great oil industry, including such highly technical sections of it as refining and cracking. The fact that only some favoured territories contain oil has introduced a new factor into the balance of international trade, resulting, for example, in large purchases of oil by British and European countries from the United States. Had world conditions remained what is termed normal, there would have been no desire to do other than buy oil of satisfactory quality at the cheapest delivered price, irrespective of its origin, but as a consequence of the dislocation of exchanges and the parlous condition of agriculture, the provision of substitutes for imported oil is being considered in a number of countries. Most of these alternatives would scarcely stand the test of scientific economics in normal times, a fact which necessitates their adoption under some form of government protection or compulsion, but it is none the less probable that, once established, a series of conditions might be set up which would favour and justify their continuation. At all events, the stimulus to invention and experiment, with the object of replacing imported oil by some other fuel, is present in all non-oil producing countries.

Petrol may be produced by the hydrogenation of coal or of low-temperature tar derived from coal and, as is well known, considerable quantities have been manufactured in this way in Germany, though it is not yet claimed that the process is a complete success, either economically or technically. A similar hydrogenation project, involving a capital expenditure of £7,000,000, has recently been the subject of controversial discussion in Great Britain: in particular, it is impossible to embark on it without a guarantee of the continuation of the present tax on petrol for a number of years, as the cost at the factory of synthetic petrol from coal is very materially greater than the price at a port of the imported article.

A car may be propelled by means of ordinary towns' gas, compressed for the purpose in cylinders, and the trials already made in this direction have shown that so far as the power obtained and the cost of the gas per mile run, the possibilities are great. The major problem is in connexion with the recharging of the cylinders and the guarantee against accident in usage. Parallel studies are being made with hydrogen gas in cylinders, the gas being generated cheaply at electric power stations during the off-peak load period.

It is, however, primarily to another liquid fuel, the production of which has a great bearing on agriculture, that we wish now particularly to refer, namely, alcohol. This is already in use in a number of countries, and it may well be that the necessity not to buy from America, which is being forced on Europe by its inability to obtain dollars, will lead to a very large development of the use of power alcohol in the near future.

It may surprise those who judge the cost of alcohol by the retail price of potable spirits that it should ever be competitive with petrol: spirits, however, are made from expensive raw materials, are maturated for seven years or longer, are sold in bottles, and carry heavy transport, selling and advertising charges, to say nothing of the excise taxation, which in itself makes up the greater bulk of their cost. Industrial alcohol to-day is made in large, highly organised factories by fermentation of the cheapest possible carbohydrate material, in particular black strap molasses, which is transported from its place of origin in tank steamers and stored in large tanks. It is pumped and handled just like oil, at a minimum cost to the user. The alcohol produced is separated from the fermentation mash in a continuous still with a minimum expenditure of steam, and can be concentrated in one continuous operation to an anhydrous product containing 99·99 per cent of alcohol, which is quite a different material from the 96 per cent spirit of a year or so ago.

It is the new method for the production of absolute alcohol which has made the advent of power alcohol certain. It is based on the well-known work of Prof. Sydney Young, namely, that a ternary mixture of three liquids will boil at a lower temperature than any one of them singly, or any mixture of two of them. Young's laboratory results have had to wait nearly thirty years for their full application to practice. Yet another example is afforded by them of the ultimate value to industry of results which were seemingly at first only of theoretical interest. It is possible and practicable to add to an aqueous alcohol a third liquid, such as benzene or, preferably, benzene with a little high-boiling petrol from a particular fraction, and drive off all the water as a ternary mixture, leaving dry or absolute alcohol behind at the lower plates of the still. The ternary mixture, when condensed, separates into two layers, the aqueous being rejected after recovery of such alcohol as it retains and the benzene being returned to the circuit. The distillation plant for this purpose appears somewhat elaborate at first sight, but when once it has been tuned up it operates with great certainty and economy. Prior to its perfection the strongest alcohol which could be obtained by distillation was of 96 per cent alcohol, and further dehydration could only be effected by means of anhydrous solids, an operation which was far too costly for the purpose in view.

The necessity for dry alcohol to mix with petrol is occasioned by the fact that in presence of more than a minimum quantity of water the mixture separates into two layers, particularly below certain temperatures. The highest proportion of absolute alcohol that can be added without requiring carburettor or engine adjustment is 15 per cent. This proportion actually gives a better fuel than with petrol alone, although the calorific value of alcohol is less than that of petrol. Ample practical tests in all countries have served to confirm the utility of alcohol as a motor fuel: it is common practice to use a proportion of it in racing cars in Great Britain. This is not the place to discuss the cost of absolute alcohol on the large scale, but there is no doubt that, suitably denatured and free from excise charges, it could be added to petrol bearing the present excise duty in Britain without materially increasing the cost, and the same applies elsewhere.

Alcohol will mix in all proportions with benzole—the home produced spirit from our gas works and coke ovens: exhaustive, and on the whole satisfactory, tests were made by the London General Omnibus Company some years ago with such fuels. The use of mixtures containing alcohol, benzole, and a third component has been tried with some success. In Germany the latest attempt at a 'home' motor spirit is to use a mixture having the percentage composition of absolute alcohol, 10; synthetic methanol, 10, made from water gas; benzole, 10, from the coke ovens; petrol, 35, made by hydrogenation of coal oil; and imported petrol, 35. Of this mixture only one-third would be imported from foreign sources, the rest being the domestic product of German agriculture, the chemical and the coke oven industries. The outcome of the experiment with so complex a fuel will be watched with considerable interest. Previously German law had required a minimum proportion of alcohol in all petrol used, which quantity had more or less equalled the capacity of the dehydrating plants a year ago. In Germany about two-thirds of the alcohol is made from potatoes, the rest coming from molasses, grain and paper pulp liquors.

France was the first country to introduce legislation making the purchase of alcohol by the oil companies compulsory. The bulk of the alcohol is used by the Paris omnibuses in the form of a 50 : 50 mixture of alcohol and petrol, the engines being specially adjusted for the purpose: such a fuel does not lend itself for general use. In France at present the conditions are not too favourable for the extension of the absolute alcohol industry, owing to the high cost of the carbohydrate material and the location and size of the distilleries, but political influences might very readily change the whole position.

In Sweden some 6 or 7 million gallons of alcohol are produced each year from the residues of the paper factories, all of which is sold in a 75 petrol : 25 alcohol mixture.

There is no need to enumerate what is being done in many other countries: in the British Empire, a mixture 'Shellkol' is marketed in Queensland. Enough has been said to indicate that, in those countries which have no petroleum supply, the study of domestic substitutes for it has become a major problem, both of economics and defence, and that in many countries national programmes are in hand to manufacture and dehydrate it in quantity. In those lands where carbohydrates can be grown cheaply and abundantly, the advantages to be derived from the use of alcohol lie in a market for surplus agricultural products. In South Africa, for example, the potentialities of cheap alcohol production are very great.

It is less than ten years since absolute alcohol was a laboratory rather than a commercial product. Its manufacture by the benzene-azeotropic process, for which the credit must be given to French enterprise, though the theory of the reaction was of English origin, has brought the world-wide utilisation of power alcohol definitely nearer now that the danger of the presence of water can be eliminated from the alcohol-petrol mixture.

If we look at the subject of international trading from the broader point of view, we are faced with the fact that at the moment many of the latest developments of modern civilisation are in danger of becoming useless. Of what value is the highly organised system of transporting materials from one country to another by land or by sea if trading be rendered impossible by lack of a medium of exchange? Even if one country, rich in a particular natural resource, is able and willing to supply the world, other countries are being forced to provide substitutes of their own, more or less adequate, never entirely justified from the point of view of world economy. In the individual countries the resources of science are being used as never before to develop these alternatives. More than ever do we need the help of science in planning the campaign of our activities, "the era of conscious and deliberate management". Are we, for example, to buy less imported petrol? Do we wish to encourage agriculture? Such are among the questions to be answered. If the reply is in the affirmative, then a plan must be prepared to be operative over a period of years, such as has been operative for beet sugar; a plan which can only be drawn by scientific experts in collaboration with the politicians, and can never be drafted by lawyers in the form of an Act of Parliament.

These anxious times demand new remedies, amongst them perhaps a body scientific which is articulate, a council of science putting on record the ascertainable facts on the broad economic questions, acting as a planning department for the best utilisation of the materials and men of the nation.

Intensive Natural History

The Natural History of Wicken Fen. Edited by Prof. J. Stanley Gardiner. Part 6. Pp. 489–652 + xii. (Cambridge: Bowes and Bowes, 1932.) 7*s.* 6*d.* net.

THE name of Wicken Fen in Cambridgeshire has long been associated in the minds of field naturalists with the flora and fauna that was probably characteristic of the whole of the 'Great Level' prior to its drainage in the seventeenth century.

Interesting to the botanist as the home of *Liparis lœselii*, *Viola stagnina*, *Cladium mariscus*, *Lathyrus palustris* and a number of other rare or local species, Wicken Fen has equal attractions for the zoologist as a locality for the very rare water beetle *Hydrochus carinatus*, the swallow-tail butterfly and many other interesting animals. Unfortunately the changes, initiated by the artificial drainage of the past, still continue and no less than six of the Lepidoptera formerly characteristic of Wicken, including the large copper (*Ocneria dispar*) and a moth, *Lælia cœnosa*, are no longer to be found there. So too with the flora, *Senecio paludosus* and *Typha minima* would both appear to have become extinct. Such changes in the past suggest an especial suitability in this area as the subject of intensive study, particularly with regard to the fluctuations in frequency, which plants and animals alike exhibit, and respecting the underlying causal factors of which we are so ignorant. These fluctuations are well illustrated at Wicken by the moth *Hydriomena sagittata* which has twice, within recent years, been apparently so scarce that it was feared to be on the verge of extinction.

This volume illustrates the great value of intensive study of a limited area, a value which will be enhanced in the future as the study of the plant and animal ecology of the area progress side by side. It is an outcome of such intensive work in a single locality that Wicken Fen has yielded four spiders which, so far as is known, are endemic, and two or three more which are known only from this locality in Britain. Nineteen ichneumon flies are here recorded by G. L. R. Hancock from Wicken as the first British records and the earthworm, *Allobophora icenorum*, described by Miss Pickford is another species new to science. It is indeed not too much to say that if the same amount of money, time and energy had been devoted in the past to intensive studies at home that has been spent on foreign expeditions, the yield to science would probably have been far greater.

It is not merely in the addition of new species, however interesting, that the value of intensive studies lies but also in the many fundamental problems upon which light is shed. It is true that the preliminary results, presented here in the fifty-six articles by a number of different authors, show little evidence of co-ordinated effort between the various branches, but such correlation will doubtless develop as the work proceeds, when such relations as may exist between the distribution of the animal population and the phases of the plant succession with their respective partial habitats, may be brought to light. In the meantime, these pages contain a large amount of information on the most diverse topics from the soil Protozoa and Collembola to the fossil vertebrates, the history of the drainage of the 'Great Level' and a comparison of the Fen of to-day with that of fifty years ago. These cannot fail to interest the biologist whatever may be his special field of interest.

The late Prof. Yapp laid a valuable foundation for future work in his account of the structure of fen vegetation from the static point of view, whilst Godwin and Tansley here develop the dynamic aspect as presented in the fen successions of which, in addition to the familiar primary succession passing from reed-swamp through 'carr' to deciduous woodland, there are recognised several 'deflected' successions consequent upon the interference of man. Data respecting the changes in level of the soil water show that the water table is slightly convex in winter and in summer concave owing to the high rate of transpiration, whilst the normally alkaline soil water contains only a small amount of dissolved oxygen and a high content of carbon dioxide.

To the concept of fenland conditions thus established future work can be related. Most of the work so far accomplished has aimed at the by no means easy task of listing the species of the area and, where possible, obtaining some measure of their relative and absolute abundance. Of vascular plants, Wicken provides less than two hundred species; but the magnitude of the work involved in a more qualitative list of the insect fauna can be realised from the fact that the Staphylinidæ alone comprise nearly two hundred and seventy species.

A perusal of these pages cannot fail to make the reader feel a debt of gratitude to those responsible for obtaining this area for the National Trust and to Prof. Stanley Gardiner for having initiated its intensive study on modern lines.

E. J. SALISBURY.

Oceanography

Bulletin of the National Research Council. No. 85: Physics of the Earth—5: Oceanography. Prepared under the auspices of the Subsidiary Committee on Oceanography. Pp. v + 581. (Washington, D.C.: National Academy of Sciences, 1932.) 5 dollars.

SUMMARIES in any branch of science are always of value to the specialist and general reader alike. In oceanography, where so much of the work is of a highly technical nature, the need is great for a practical textbook giving not only a general survey of this vast and varied field, but also assisting towards a better knowledge of the newer and more specialised sections of research.

We think the present volume adequately fulfils such a function.

The work is a composite effort by a number of separate authors, each chapter being contributed by a specialist. The result is, in most cases, a lucid and up-to-date account of each particular theme, such as would be difficult or impossible for anyone but a specialist to produce. In nearly every case, a satisfactory bibliography is included. The chapters are of varying merit, strikingly dissimilar in method of treatment and style; at least one section has been expanded unnecessarily and occasionally considerable repetition occurs. All these are the obvious and more or less inevitable results of the composite method of production.

In the first section of the book, Littlehales gives a concise and lucid summary of the present state of our knowledge of the configuration of the ocean bottom and includes definitions of the terms used in its description. Then Collet classifies bottom deposits from physical, chemical and biological points of view, but it is to be regretted that he does not add a bibliography.

"Properties of Sea Water" is the next section and in our opinion the best. Here Prof. Thomas G. Thompson deals with the physical properties in detail, and in association with Robinson provides an admirable treatise on "The Chemistry of the Sea". Some space is devoted to descriptions of the more usual types of water samplers, the rest to a discussion of the substances found in ocean water, even those present in minute traces. The accounts of carbon dioxide equilibrium and of the physical chemistry of oceanic salt deposition (Igelsrud) are of great interest.

In the "Movements of the Sea" are considered waves, tides and currents, dynamic oceanography, ocean circulation and ice in the sea. With perhaps the exception of "Dynamic Oceanography", the subjects are treated on orthodox lines. The next section, devoted to oceanographical instruments and methods, is largely confined to a consideration of the apparatus used on the last cruise of the *Carnegie*. The most interesting portion is the short chapter by Iselin on bottom samplers. Unfortunately, no consideration is given to biological equipment as such.

The book concludes with a consideration of the "Interrelations of Oceanography" under the separate heads of meteorology (C. F. Brooks), biology (A. G. Huntsman) and geology (C. Schuchert). While quite interesting, some portions at least could have been shortened with profit.

The volume covers a large field in an astonishingly efficient manner; and while full of technical and highly specialised information, should provide interesting reading even for those with but a casual interest in this branch of science.

E. F. T.

Tribes of the Southern Sudan

Pagan Tribes of the Nilotic Sudan. By Prof. C. G. Seligman and Brenda Z. Seligman. (The Ethnology of Africa, edited by J. H. Driberg and Dr. I. Schapera.) Pp. xxiv + 565 + 61 plates. (London: George Routledge and Sons, Ltd., 1932.) 42*s*. net.

THIS book is the second to be published in a series of works on the ethnology of Africa edited by Mr. J. H. Driberg and Dr. I. Schapera. In his introduction to the book, Sir Harold MacMichael, Civil Secretary to the Sudan Government, points out that though a good deal has been written at one time or another concerning various tribes inhabiting the southern Sudan, the information has been somewhat fragmentary and not always reliable; and accordingly Prof. and Mrs. Seligman's work being, as it is, a general conspectus of the people, their traditions, their culture and ways of thought, cannot fail to be of great practical value to their fellow workers and to the administration of the Sudan.

Much of the introduction might be quoted to show the value of anthropological research as applied to the business of administration, and an authoritative statement, coming as it does from so able and distinguished a public servant as Sir Harold MacMichael, is all the more welcome. The Sudan Government has always taken interest in and given help in a practical way to ethnological investigation, an example which our Colonial Office has been slow to imitate, and which might have saved some blundering.

When working with so many different tribes, the question of an orthography must always present difficulties, and the authors are much to be congratulated on having worked out a suitable compromise, though I should have preferred to have seen *Lugbware* modernised further to its recognised form *Lugbwara*.

I like the schema of Nilotic and Nilo-Hamitic migration on p. 19, and think it will be more generally accepted than some which have been published; though at the same time, I should prefer to reserve judgment on the placing of the Lendu in the same group with the Lugbwara

(p. 463); there may be affinities in language, but physically they seemed to me to be of a different race altogether.

I was interested to see the account given by Mr. R. Gunnis of Olia's rain-stones (p. 131), because I was present when this took place, but I do not remember the incident of the breaking of the mud floor; the impression I hold was that the stones were in a pot buried in the floor, the top of the pot being flush with the floor. The stones were similar to those I had seen at Shindiro. Olia was somewhat of a puzzle; he reckoned himself as being pure Acholi, but he had some bits of things which he said had been given to his ancestors when they had visited the Mukama of Bunyoro; he had these rain-stones, and he lived next the Madi. I have always understood that the Madi crossed the Nile below Nimule about sixty years ago, after a famine, and lived on land formerly in occupation of the Acholi. At Atiak some intermarriage had taken place, and Olia's followers were not all pure Acholi, and had indeed adopted some Madi customs.

Now one of the most interesting points brought out by Rogers in his account of the Madi rain-stones (*Man*, 27, 58; 1927) is the number of chiefs who had these stones, twenty-two in a population of about eight thousand adult males, which looks very much as if each territorial chief tried to obtain the ascendency over his fellows by becoming a rain chief, for that area is subject to periodical food shortages. Is it not possible that Olia's forbears took a similar course, for his country is also in a dry zone? This is only speculation, founded on impressions rather than facts, because one has to remember that the southern Acholi do not ordinarily have rain-makers. That the Acholi of the southern Sudan also have rain-makers seems to me only to show what we know to be true, that they are of mixed origin. The point now is to determine how long it is since the chief of Atiak set himself up to be a rain-chief, or, alternatively, is he of such pure Acholi stock as he is usually represented to be?

The authors have been set an almost impossible task, that of bringing within the covers of a single book an account of all the tribes of the southern Sudan, tribes of widely different cultures, and some about whom we know very little. It is apparent also that they have found considerable difficulty in reconciling observations made by different investigators. That they have succeeded as well as they have done is a matter of great credit to them, and one feels that though there must of necessity be gaps in the picture they have drawn of the life of any one particular tribe, such gaps may be filled in by the administrator or missionary who is working in that tribe from knowledge gained in his own experience.

The book is well illustrated, and though one may grumble at the price, one cannot get away from the fact that here there is, in convenient form, all that is now known on certain aspects of native life in the southern Sudan, and the very incompleteness of our knowledge may stimulate others to investigate and publish matter which will give us the full story. E. B. HADDON.

Short Reviews

Festivals and Songs of Ancient China. By Prof. Marcel Granet. Translated from the French by Dr. E. D. Edwards. (The Broadway Oriental Library.) Pp. ix + 281. (London: George Routledge and Sons, Ltd., 1932.) 18*s.* net.

THE English version of Prof. Granet's study and interpretation of certain odes of the Chinese classic, the "Shih Ching", is addressed to a wider public than the sinologue and differs from the French edition in the omission of the original texts and the Chinese characters in the notes. Scholars may regret it; but if, as the translator hints, this has made possible the production of Prof. Granet's remarkably penetrating analysis of the poems in a form more accessible than that of the original edition, it is a gain rather than a loss.

For the benefit of those who have not had the advantage of knowing the work in its original form, it may be said that the author takes certain of the love poems of the "Book of Odes" and, setting aside the symbolic and archæological interpretations of the Chinese commentators, regards them as survivals of what were once genuine expressions of an emotion. Analysing them from this point of view, he infers that they are parts of a forgotten socio-religious seasonal ritual of a primitive rustic organism—a village festival which served to reaffirm the social bond by affording an opportunity for the meeting of family or local groups and of members of the two sexes, isolated at other times of the year. These songs were, he holds, the material of an antiphonal contest between the sexes which culminated in betrothal and marriage. Prof. Granet quotes extracts from the records of travellers in the Far East which lend support to this original view.

Needless to say, nothing of this appears in the Chinese commentaries. Their interpretations, however, which are given, are not without significance, in spite of their divergence from Prof. Granet's purpose. As an example of Chinese literary canons and symbolism they illuminate the psychology of a remarkable literary tradition.

Bauxite and Aluminous Laterite: a Treatise discussing in Detail the Origin, Constitution, known Occurrences and Commercial Uses of Bauxite. By Dr. Cyril S. Fox. Second edition, partly rewritten and enlarged. Pp. xxxi + 312. (London: Crosby Lockwood and Son, 1932.) 30*s*. net.

IN the interval since the publication of the first edition of Dr. Fox's book (noticed in NATURE, 120, 800; 1927), a feature of the bauxite industry has been the increased production from southern Europe, in particular from Hungary and Yugoslavia. Most of the new matter in the second edition results from a visit by the author, in company with local geologists and mining engineers, to the deposits of Austria, Hungary, Italy and Yugoslavia. The exact mode of origin of the important European deposits has always been a matter of some uncertainty, and linguistic difficulties have tended to hamper British geologists in the study of the literature of these deposits. New information on this subject is therefore welcome.

The author's observations, and those of local geologists, have led him to put forward the view that the so-called Mediterranean or *terra rossa* type of bauxite is not a residual deposit, but a true sediment, laid down in water. He still thinks it very probable, however, that both true *terra rossa* and the bauxite of the limestone regions of southern Europe are derived from a common origin—the impurities of the limestones.

The new matter is incorporated in an introduction and a supplementary chapter. An important omission from the bibliography, which has not been brought up to date, is de Lapparent's recent memoir, "Les Bauxites de la France méridionale." (*Mém. de la Carte géol. de la France*, 1930.) Statistical information, which can be obtained from current government publications, is omitted from this edition. Otherwise the book is little changed.

V. A. E.

Proverbes et maximes Peuls et Toucouleurs traduits, expliqués et annotés. Par Henri Gaden. (Université de Paris: Travaux et mémoires de l'Institut d'Ethnologie, Tome 16.) Pp. xxxiii + 368. (Paris: Institut d'Ethnologie, 1931.) 56.25 francs.

M. HENRI GADEN'S collection of proverbs comes mainly, but not exclusively, from peoples encountered at St. Louis in French West Africa. The author has classified them under various headings, such as personal relations and the family, authority, good and evil, courage and intelligence, goodwill and avarice, life in general, practical wisdom, respect for tradition and the like. He has wisely added explanations and annotations freely; for many of the proverbs belong to the category specifically recognised by the people themselves, in which by allusion the meaning is shown to be quite other than that conveyed ostensibly by the words employed. Another and frequently recurring type belongs to the class which conveys a moral. Allusions to magical belief are common and can usually be shown to lie behind the proverbs which express distrust or dislike of neighbours. The occurrence of a succession of premature deaths among children or live stock in a house, for example, will be attributed to the proximity of a sorcerer as a neighbour, who, by the force of his nature, is compelled to seize upon the *bâlu*, the 'shadow' or 'image' of his victim, especially when it leaves the body during sleep.

M. Gaden prefaces his collection by an introduction dealing with language and vocabulary, and has added a very full and useful index of all the vernacular key words which occur in the proverbs.

Electricity and Magnetism for Beginners. By W. C. Badcock and Dr. E. J. Holmyard. (Dent's Modern Science Series.) Pp. viii + 199 + 8 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1931.) 2*s*. 6*d*.

THIS is a very welcome addition to the growing number of books written in what we may venture to call the good modern style; that is, not just a descriptive catalogue of marvels, or a collection of things to do made to appear of educative value by the free use of all the latest terms, though the background essential to their understanding is entirely lacking; but a really clear survey of the subject bringing out the fundamental principles, without a comprehension of which no real progress can be made, and written in an easy conversational mode, interesting historical references and practical applications falling naturally into place in the coherent story.

There is, however, we suggest, one very real danger in this sort of thing, particularly when done as well as it is in the present case: the book is not, indeed as the authors say, could not be, mathematical; but so comprehensive is its range and so lucid the qualitative explanation of the varied phenomena dealt with, that when the time comes for the more complete quantitative treatment the pupil may find the 'gilt all off the gingerbread', and his interest suffer accordingly.

Elastic Energy Theory. By Prof. J. A. van den Broek. Pp. x + 260. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 22*s*. 6*d*. net.

VARIOUS methods are at hand for the analysis of statically indeterminate structures. The author, feeling that the elastic energy theory is inadequately treated in British or American textbooks dealing with strength of materials, has developed the theory systematically and has applied it to a wide range of redundant frames and beams.

A. F.

The Scientific Work of Joseph Priestley

By PROF. J. R. PARTINGTON, M.B.E.

PRIESTLEY'S most important scientific work was the result of a further development of the experimental technique available in his day for the manipulation of gases. This led him to the discovery of a number of new gases, and the creation of a special branch of chemistry called in the older books "Pneumatic Chemistry". The ascertained facts enabled Lavoisier to make such changes in the theory of chemistry that he may fairly be called the founder of the science as we know it to-day.

The existence of gases with characteristic properties was known before Priestley's time. Van Helmont, about 1620, had recognised the existence of at least two gases different from air, gas sylvestre (carbon dioxide) and gas pingue (hydrogen or hydrocarbons), and had invented the name gas, derived from chaos, which Priestley did not use. Van Helmont did not succeed in collecting gases; when the materials generating a gas, a process previously called "intestine fermentation", were sealed up in a glass vessel, the latter was "filled with plentiful exhalation (yet an invisible one) and however it may be feigned to be stronger than iron, yet it straightway dangerously leapeth asunder into broken pieces".

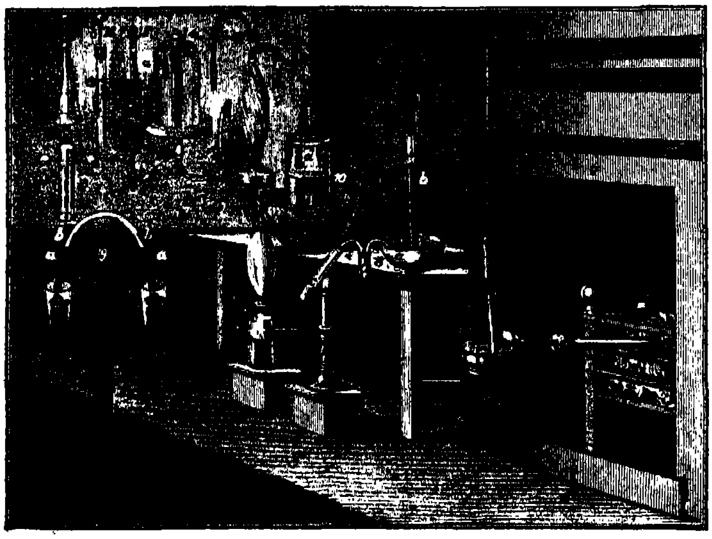

FIG. 1. Part of Priestley's Laboratory. From "Experiments and Observations on Different Kinds of Air".

Hydrogen was first collected from iron nails and dilute acid in an inverted bottle by Boyle: "the cavity of the glass was possessed by the air, since by its spring it was able to hinder the liquor from regaining its former place". Boyle also showed that hydrogen was combustible and would not burn without air. A little further progress in the manipulation of gases was made by Mayow (1674), and Stephen Hales ("Vegetable Staticks", 1727) collected over water in an inverted globe the "air" given off when all kinds of substances, such as saltpetre and coal, were heated in a gun barrel, or when sulphuric and nitric acids acted on metals. Hales measured these airs and then apparently threw them away without examining their chemical properties, regarding them all as modified air. His severely quantitative technique seems to have been influenced by the writings of Newton who, as Priestley says, "as he had very little knowledge of air, so he had few doubts concerning it". Cavendish in 1766 collected fixed air (carbon dioxide), discovered by Black in 1754, over water and mercury, and carefully investigated its properties, as well as those of inflammable air (hydrogen), discovered by Boyle. He used drying tubes and determined the densities and the solubilities of the gases in water and alcohol. The first use of mercury for collecting soluble gases is incorrectly attributed by Kopp to Priestley.

Cavendish's pneumatic trough had no shelf, a fitting introduced in a crude form by William Brownrigg, of Whitehaven, whose paper appeared in 1765, although it had been communicated to the Royal Society twenty-four years previously and was known to Hales and probably to Cavendish. Scheele, who used very simple apparatus and collected the gases in bladders (as did Cavendish) as well as jars, carried out his investigations from 1770 to 1772 (or 1773), but the work was not published until 1777, so that Priestley's discovery of oxygen in 1774 was made independently of Scheele's work.

Priestley's researches on gases were initiated by a chance event. In 1768 he lived at Leeds near what he calls a public brewery, and began to make experiments on the fixed air, "of which there is always a large body ready formed, upon the surface of the fermenting liquor". He showed that it could be absorbed by water to make an artificial Pyrmont water, and devised an apparatus for producing it from chalk and oil of vitriol, his supply at the brewery having been cut short by an unfortunate experiment in which a vat of beer was spoiled. He thought the reason for the turbidity produced in lime water by air in which a candle had burnt out was that "flame disposes the common air to deposit the fixed air it contains", an inability to furnish a correct explanation for a good experiment which is typical of his work from first to last.

Priestley took as his guide in chemical experiments a theory which he found exclusively professed by the chemists of his day, that reversion to the conceptions of Plato and Aristotle called the theory of phlogiston. He has been reproached for his use of this theory, but clearly unjustly, since the theory was as inextricably entangled in the scientific thought of the eighteenth century as that of the ether a century later or the electron to-day. Macquer, writing in 1778, refers to it as "the surest guide we can take in chemical experiments"; Fourcroy continued to teach it until 1786–87 and Berthollet until 1785. Cavendish, a man of the highest intellectual capacity, believed in it, so far as we know, until his death in 1810, and Priestley still defended it in his last work, "The Doctrine of Phlogiston Established", in 1800 and 1803. It persisted in Germany after this. It is too much to expect a Laocoon to throw off such coils; a Hercules such as Lavoisier was necessary.

The researches on gases carried out by Priestley are collected in six volumes of "Experiments and Observations on Different Kinds of Air" (1774–86; abridged in three volumes, 1790; a modern abridgement in one volume for the use of students is much to be desired). Its title is correct, and the work itself reveals clearly the progress made by the mind and hands of the great experimenter. The results are given in the order in which they were found, as in Faraday's publications, and the apparent lack of order, systematisation and condensation, which intrudes on the attention of a hurried reader, is responsible for the incorrect judgment of the historians of chemistry, that Priestley was a hasty and careless worker. He certainly left too many experiments unfinished and failed to follow up many interesting results. His range of tests was too restricted, a lighted candle and a living mouse being his favourite 'reagents'.

Priestley's apparatus was simple, being, as he says, "nothing more than the apparatus of Dr. Hales, Dr. Brownrigg and Mr. Cavendish, diversified and made a little more simple". He worked in the midst of his family and Fig. 1 shows his laboratory. A substance is being heated in a gun barrel in the fire, the evolved gas being collected in a suspended pneumatic trough over mercury. A substance in the tube 8 *c* is heated by a candle and the gas, after passing through a trap *d* to separate any liquid carried over, is collected over mercury in 8 *b*. In 10, a gas evolved in the bottle *c* is collected over water, passing through a bladder on the way so as to allow of the bottle being agitated, rubber tubing being then unknown. Some apparatus is shown on the chart at the back, and 19 is a piece of apparatus for passing electric sparks through a gas, as used by Cavendish.

The pneumatic trough, which is in its modern form, and auxiliary apparatus, are shown in Fig. 2. The trough, which is provided with a fixed shelf, contains water. The jars *c*, *f* and *d* stand on the shelf *bb*, the jar *c* receiving gas from the bottle *e* fitted with a bent glass delivery tube. In the inverted glass *d* is a mouse, these animals being kept in the arrangement 3. The jar *f* contains a cup supported on a wire stand, also shown in 5; in the cup a substance may be exposed to the gas and if necessary heated by a burning glass. A plant is shown growing in the gas jar 2, and other small pieces of apparatus may be seen. The mice used were kept on "a shelf over the kitchen fireplace where, as is usual in Yorkshire, the fire never goes out". They live, he found, entirely without water and when passed through water "they require and will bear a very considerable degree of heat to warm and dry them".

With such apparatus Priestley investigated the properties of fixed air and inflammable air, discovered three gaseous oxides of nitrogen, ammonia gas (alkaline air), hydrogen chloride (acid air), sulphur dioxide (vitriolic acid air) and silicon fluoride (fluor acid air). The experiments on the oxides of nitrogen are particularly detailed and interesting.

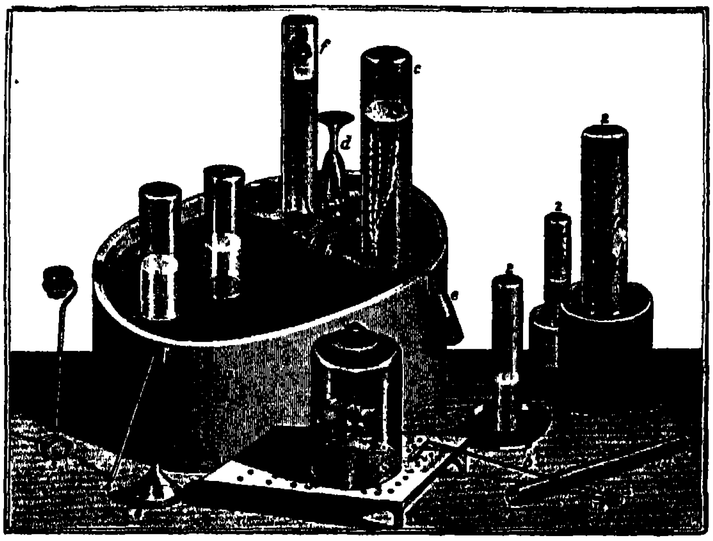

FIG. 2. Pneumatic trough and other apparatus. From "Experiments and Observations on Different Kinds of Air".

The discovery of oxygen on August 1, 1774, in the house of his patron, Lord Shelburne, falls somewhat apart from the rest of Priestley's investigations on gases. It was rather a chance discovery, the result of an experiment performed without definite purpose, as though "more is owing to what we call chance, that is, philosophically speaking, to the observation of events arising from unknown causes, than to any proper design or preconceived theory in this business". Among other materials heated in small tubes over mercury by means of a large burning glass was red precipitate of mercury, from which a gas was evolved in which a candle "burned with a remarkably vigorous flame . . . I was utterly at a loss how to account for it". After the candle came the mouse, and after the mouse Priestley himself. He found that the new air was respirable: "who can tell but that, in time, this pure air may become a fashionable article of luxury. Hitherto only two mice and myself have had the privilege of breathing it". He suggested the use of oxygen in cases of pneumonia, and in the production of high temperatures.

Priestley believed in rapid publication, as did Faraday: "a person who means to serve the cause of science effectually, must hazard his own reputation so far as to risk mistakes in things of less moment", and all his results were available without delay to others, who could make better use of them than he could himself.

In August 1771 Priestley had found that vegetation, such as growing mint, spinach and groundsel, restores air vitiated by burning candles or by the breathing of animals: "the injury which is continually done to the atmosphere by the respiration of such a large number of animals . . . is, in part at least, repaired by the vegetable creation". In 1778 he found that water plants growing in water containing fixed air evolve oxygen. The part played by light in the process of photosynthesis, although known to Priestley, was more fully worked out by Ingen-Houss in 1779.

Another "random experiment", made in 1781, in which moisture was found to result from the explosion of a mixture of common air and inflammable air, led to Cavendish's research on the formation of water from hydrogen and oxygen. In Priestley's own extension of this work, considerable confusion and error resulted from his neglect to distinguish clearly between hydrogen and other combustible gases, such as carbon monoxide and hydrocarbons. This confusion remained until about 1800, when Cruickshank, of Woolwich, cleared up the matter.

Neither Priestley nor Cavendish was able to draw correct conclusions from his experiments. This was reserved for Lavoisier, "a great architect, who laboured little in the quarry" in the obscurity of which the two experimenters worked. Priestley never professed to be a chemist, and in the full sense of the word never was. His range of knowledge was too restricted, and he was thus incapable of appreciating the correct interpretations of his experiments when they were clearly placed before him.

Priestley's mind was powerful and broad: he was a good classical, oriental and modern linguist, who was able to argue points of theology with more orthodox divines with the scriptures in the original languages. He also had read extensively in philosophy and theology, and became involved in politics. His days became more and more occupied with these pursuits and he was the object of a growing animosity which finally hounded him from England to America, where he died. Although his experimental work imposed itself with unescapeable mastery on contemporary science, his theoretical contributions were negligible. Careful scientific thought does not flourish in such an environment.

No adequate account of Priestley's work in physics seems to be available. He published in 1767 a "History of Electricity", a subject which he calls his "favourite amusement". The experiments in electricity were begun at Nantwich and the book written in Warrington, with the encouragement of Benjamin Franklin. It contains an excellent account of early work in electricity and some new experiments, as well as the argument that electric forces obey an inverse square law because of the absence of charge inside a hollow conductor. In two papers published in 1769, "On the Lateral Force of Electric Explosions", he showed that a discharge from a Leyden jar when sent through a circuit composed of a metal chain with the ends brought together so as to form a small air gap, would in part jump the air gap of high resistance rather than pass through the metallic loop. In 1772 appeared two volumes on "The History and Present State of Discoveries Relating to Vision, Light and Colours", which were not so well received as the history of electricity.

"Human happiness", Priestley tells us in a characteristically discursive preface to the "History of Electricity", "depends chiefly upon having some object to pursue, and upon the vigour with which our faculties are exerted in the pursuit". He was happy in having several objects for the exercise of his vigorous and original mind. In science he was a great explorer, opening out in his rapid and fortunate survey a great number of sites, the rich treasures of which he left to others, equipped with greater patience and knowledge, to remove, arrange, classify and interpret. Such a pioneer fills a place in the annals of human achievement, and such a one was Joseph Priestley, the bicentenary of whose birth we now gratefully remember.

Priestley's Associations with London

By H. G. WAYLING

JOSEPH PRIESTLEY knew London well. Although he officiated for several years as a Dissenting minister at Nantwich and at Leeds, before coming to reside in London as Lord Shelburne's librarian, yet he generally managed to spend a month every year in the metropolis. His friendship with men like Benjamin Franklin, Dr. Richard Price, John Canton and Andrew Kippis encouraged him, while still a provincial pastor, to study natural philosophy earnestly. He speaks of the happy hours spent in their company at the London Coffee House on Ludgate Hill, the back premises of which abutted on to the Old Sessions House in Newgate. Over their cups, these philosophical enthusiasts discussed topical questions and laid plans for prospective publications.

A few yards higher up Ludgate Hill in St. Paul's churchyard, lived Joseph Johnson, the bookseller who acted as Priestley's literary and commercial agent. Priestley's correspondence was often directed to Johnson, at whose house the itinerant cleric also occasionally lodged. Another business acquaintance on whom he called was Edward Nairne, a mathematical instrument maker to the Royal Exchange, who lived at 20 Cornhill. Nairne supplied electrical machines and air-pumps to Priestley, who, in one of his letters, directs attention to the fact that the recently imported commodity, caoutchouc, could be purchased at this establishment.

Priestley must have been very familiar with the road from the Royal Exchange to Westminster. At 36 Craven Street, Strand, where Benjamin Franklin lodged—a tablet on the house commemorates the fact—Priestley was a frequent caller, sometimes dining with the distinguished American, who, like himself, was a member of the congregation assembling at the Essex House Chapel, Essex Street, just opposite the Courts of Justice. Sometimes he preached at this church, giving a rest to his great personal friend, the Rev. Theophilus Lindsey, the officiating minister. A little to the east of the Law Courts is Chancery Lane, connecting the Strand with Holborn, and in this latter thoroughfare, at Featherstone Buildings, Priestley, as Lindsey's guest, was always *persona grata*. These buildings, which are to the west of Chancery Lane and on the north side of Holborn, are famous also as the temporary home of Sir Walter Besant, when he was a student at King's College, and at the corner house Sheridan and Miss Linley first set up housekeeping after their elopement from Bath. Another of Priestley's clerical friends was Dr. Andrew Kippis, the biographer of John Canton, the Spitalfields schoolmaster, and likewise of Sir John Pringle, P.R.S.

As a preacher with a slight stammer, Priestley would not be at his best as a rhetorician, but in the library or round the festive board, what eruditional entertainments he must have given. Can there be any doubt of the many cordial invitations he received when he came to London on his annual trip? Sometimes he stayed with Kippis in Whitcomb Street, parallel to the Haymarket, at other times with Dr. Price, who resided at Newington Green. It was this latter Nonconformist, who delivered a discourse on civil liberty at his chapel in the Old Jewry, Cheapside, which roused the ire of Edmund Burke to white heat. In the same place of worship, Priestley performed the mournful duty of preaching his friend's funeral sermon.

Having given some space to Priestley's devotional labours, it remains to mention those dealing with his scientific occupations. In 1773, he came to London as librarian and companion to Lord Shelburne, whose town residence, Lansdowne House, Berkeley Square, has recently been demolished. This post was ideally congenial to a man of Priestley's temperament and ability. The duties of his office were slight. In apartments reserved exclusively for him, he worked without let or hindrance. Distinguished foreigners paid visits to his laboratory and now and then William Pitt called on him to keep in touch with his latest experiments. At Lansdowne House on August 1, 1774, Priestley discovered oxygen, an event that will always be associated with his name.

After he left the service of Lord Shelburne, Priestley settled in Birmingham until a riotous rabble fired his house and chapel and caused him once again to seek safety among metropolitan sympathisers. Shortly after his flight to London, he was appointed to succeed Richard Price at the Gravel-pit Meeting House near Mare Street, Hackney. At this place of worship, he delivered his farewell sermon before sailing for America. His very last Sunday, however, was spent at the chapel in Essex Street, his friends "Sorrowing most of all at the words which he spake, that they would see his face no more". Next day he departed by river for Gravesend.

The Recent Japanese Earthquake

By Dr. C. Davison

ONE of the greatest earthquakes of the present century—a century that includes the Kansu earthquake of 1920 and the Kwanto earthquake of 1923—occurred off the east coast of Japan at about 5.31 p.m. on March 2, G.M.T. (or March 3, 2.31 a.m., Japanese time). The centre, as determined from the Kew record, lay in about lat. 40° N., long. 144½° E. This point is 140 miles from the north-east coast of Japan, near the foot of the western slope of the Tuscaroora Deep, the depth of water in this region being 4,000 fathoms or about 4½ miles. It is, as Prof. Milne pointed out many years ago, the seat of some of the most violent of all Japanese earthquakes. Among them may be included those of the years 1563, 1659 and 1896, and perhaps that of 1668.

This centre is so distant from land that the destructive effects of the actual shock are not as a rule important. The recent earthquake was, however, of such strength that pictures were dislodged and ornaments thrown down within a district 235 miles in length from Morioka to Maebashi. It was strongest along the 54 miles of coast between Fudai and Kamaishi. As usual in great earthquakes, the shock was of considerable duration. At the observatory of Aomori, it was sensible for eight minutes, the greatest horizontal movement registered there being 87 mm. or about 3½ in. At Tokyo, where it did not even shake down plaster or stop clocks, it was felt for four minutes.

Though much damage was caused by the

earthquake and subsequent fires, the sea-waves were responsible for the greater part. In the Iwaki prefecture, that immediately to the west of the epicentre, the sea-waves advanced in the form of a wall of water from four to seven feet in height, that swept away villages along the coast and wrecked several small towns. At Kamaishi, the sea-wall was broken down by the waves and 1,500 houses were destroyed.

The loss of life and the injury to property were considerable. According to official figures issued on March 5, 1,560 persons were killed, 956 are missing and 354 wounded; while 2,878 houses were washed away, 1,458 were thrown down, and 211 burned.

One of the most notable predecessors of the recent earthquake was that which occurred on June 15, 1896, and is known as the Sanriku earthquake. According to Omori and Hirata (*J. Coll. Sci., Tokyo Imp. Univ.*, vol. 11, pp. 161–195; 1899), its epicentre lay in lat. 39° N., long. 144½° E., or some miles to the south of that of the recent earthquake.

In Japan, as elsewhere, great earthquakes seldom visit the same region, except at long intervals of time. The centres of successive earthquakes belonging to the same seismic zone are rather displaced some or many miles—in this case perhaps sixty miles—along that zone. On land, the Sanriku earthquake was much less violent than the recent shock, though it was felt to a distance of 320 miles from its centre, but it was followed by far greater sea-waves. All eye-estimates of the height of sea-waves are subject to large errors, and we cannot have much confidence in such figures as 94 ft. at Yoshihama and 60 ft. or 100 ft. along the eastern coast of Hokkaido. At Ayukawa, however, which is 170 miles from the epicentre, the tide-gauge showed for the chief movement a rise of 8 ft. above the usual level, followed by a fall of the same amount below it. The waves were certainly large enough to be recorded at Honolulu and Sausalito, at the entrance to San Francisco Bay, the latter station being 4,787 miles from the epicentre.

In 1896, the sea-waves were far more destructive to life and property than those of the present year. In Kamaishi, 4,700 of the 6,557 inhabitants were drowned and 88 per cent of the houses were swept away. Along the whole coast affected, the number of lives lost amounted to 28,321, and of houses ruined to 6,222.

Obituary

LORD LOVAT, K.T., G.C.V.O., K.C.M.G.

THE death of Lord Lovat on February 18 will prove a great loss to forestry both in Great Britain and throughout the Empire. To his strong personality, tireless energy and great grasp of detail, Great Britain owes it to-day that she has a Forestry Commission in being, a considerable addition to the afforested area, and, it may be justifiably hoped, a settled forest policy. In future years it may come to be recognised that Lord Lovat's greatest claim to remembrance by his fellow countrymen will be the great part he played in a resuscitation of the national forestry question, which had practically lain dormant for more than a century.

Lord Lovat's interest in forestry, from a wider point of view than his own estates, was aroused before the War. In the latter part of the great struggle he acted as Director of Forestry in France, to co-ordinate the forestry operations being carried out with the object of supplying the troops in the field with the essential timber and other products of the forests. During this period, he was one of the originators of the Acland Report drawn up as a result of the Departmental inquiry, 1916–17, with the object of pressing upon the Government the paramount necessity of taking up the question of afforestation in Britain at the close of hostilities.

A Forestry Bill to this end was presented to Parliament and passed in 1919 and Lord Lovat was appointed in 1920 chairman of the Forestry Commission, which was empowered to carry out the provisions of the Bill. With the object of leaving the new Commission free from politics, a Treasury allotment was made and the Commission was not placed under a minister of the Crown.

With that energy and vitality for which he was renowned, Lord Lovat at once devoted himself to this new business, which involved commencing a planting campaign on land to be obtained from private individuals, since no State-owned land existed. That the organisation he and his Commissioners introduced was effective is proved by the fact that when he resigned the chairmanship in 1927 some 94,289 acres had been afforested and 391,511 acres of land had been acquired by the State. Before he resigned his post, with the spirit of generosity which animated him, he stated publicly: "If any good work has been done by the Forestry Commission, it does not lie with me but with the excellent body of Commissioners and staff which we have in the Forestry Commission." Yet it was an open secret that, but for Lord Lovat, the 'Geddes axe' might have brought the work of the Forestry Commissioners to an abrupt end and that on several occasions serious changes in policy were only prevented by his influence and tact.

Lord Lovat was chairman of the first Empire Forestry Conference, held in London in 1920 after the formation of the Commission, and of the second held in Canada in 1923, during which he visited most of the forests in the Dominion.

In connexion with forestry education and research, Lord Lovat held strong views which were not always in accordance with those of the universities as a whole. As a result of the Conference in Canada, he was able to give effect to his scheme of establishing an Imperial Forestry Institute at Oxford with the support of grants from the Colonial Office in London and grants from certain Dominions and Colonies. The position which the Institute has taken in the eyes of the Empire justifies Lord Lovat's prescience in this matter. He was also responsible in no small degree for the revival of scientific research in forestry problems.

In 1927 Lord Lovat became Parliamentary Under Secretary of State for Dominion Affairs and chairman of the Overseas Settlement Committee. He was also chairman of the Committees on Agriculture in the Colonies and on Colonial Veterinary Sciences. These positions he resigned in 1929.

From 1927 until his death, Lord Lovat maintained his keen interest in the forestry question in Great Britain and linked to it the broader one of Empire forestry and Empire timber marketing and development as a whole. It is perhaps not too much to say that, outside India, the position of forestry throughout the Empire and the appreciation, which is now making headway at headquarters in London and elsewhere, is due to the vital force which Lord Lovat's invigorating personality gave to it. E. P. Stebbing.

Prof. Max Wolf

Prof. Max Wolf died on October 3, at the age of sixty-eight years. He was the son of a physician at Heidelberg, and showed an aptitude for astronomy from his youth. While still at school he erected a small observatory, with an equatorial built by himself; in 1884 he discovered the interesting short-period comet that bears his name.

Wolf soon adopted photographic methods and made the first photographic discovery of a minor planet in 1891. He and his assistants afterwards added many hundreds more. The first discovery was afterwards named Brucia, in appreciation of the gift of a double camera by Miss Wolfe-Bruce. He was appointed a supernumerary professor at Heidelberg in 1893, and succeeded to the ordinary professorship in 1902. He devoted himself to photography of the nebulæ and their spectra, and was the first to detect the expanding nebula round Nova Persei in 1901; he found evidence of rotation in the nebula Messier 81, and discovered the extended nebulosity that surrounds the Pleiades.

Prof. Wolf was one of the first to use the stereoscopic method for detecting proper motions of stars, by comparison of plates taken some years apart. He published several lists of stars with large proper motions. An article by H. Vogt in *Astronomische Nachrichten*, No. 5921, pays tribute to the excellence of his teaching at Heidelberg, and his popularity.

He received the gold medal of the Royal Astronomical Society, and similar honours from many other countries. In spite of failing health, he continued at work until the last, and made several planetary discoveries in 1932.

A. C. D. C.

We regret to announce the following deaths:

Prof. Carl E. Correns, director of the Kaiser-Wilhelm Institut für Biologie at Berlin-Dahlem, Darwin medallist in 1932 of the Royal Society, on February 15, aged sixty-nine years.

Prof. E. E. Haskell, emeritus professor of experimental hydraulics in Cornell University, and dean of the College of Civil Engineering at the University in 1906–21, on January 28, aged seventy-seven years.

Dr. H. L. Snape, lately chairman of the Association of Directors and Secretaries of Education of the Union of Lancashire and Cheshire Educational Institutes, formerly professor of chemistry at University College, Aberystwyth, on March 2, aged seventy-one years.

Dr. Victor Sterki, assistant curator of Mollusca in the Carnegie Museum, Pittsburgh, since 1909, who has done much work on the anatomy, systematics and distribution of Mollusca, etc., on January 25, aged eighty-six years.

News and Views

Recommendations for Election to the Royal Society

The Council of the Royal Society has agreed to recommend for election into the Society the following seventeen candidates: Mr. P. M. S. Blackett, lecturer in physics in the University of Cambridge; Prof. J. B. Collip, professor of biochemistry in McGill University, Montreal; Col. R. E. B. Crompton, electrical engineer; Prof. H. M. Dawson, professor of physical chemistry in the University of Leeds; Dr. A. T. Doodson, associate director of Liverpool Observatory and Tidal Institute; Dr. H. J. Gough, superintendent of the Engineering Department of the National Physical Laboratory, Teddington; Mr. J. Hammond, senior assistant at the Animal Nutrition Research Institute, Cambridge; Dr. G. M. Holmes, physician to the National Hospital for Nervous Diseases, Queen Square, London; Dr. H. King, chemist at the National Institute for Medical Research, Hampstead; Prof. J. E. Lennard-Jones, Plummer professor of theoretical chemistry in the University of Cambridge; Prof. J. W. McLeod, professor of bacteriology in the University of Leeds; Dr. A. S. Parkes, physiologist, Foulerton student of the Royal Society; Prof. E. J. Salisbury, Quain professor of botany at University College, London; Dr. B. Smith, district geologist of H.M. Geological Survey; Dr. W. R. Thompson, superintendent of Farnham House Laboratory of the Imperial Institute of Entomology (London and Farnham Royal); Prof. A. M. Tyndall, Henry Overton Wills professor of physics in the University of Bristol; Prof. J. H. M. Wedderburn, professor of mathematics in Princeton University.

Elections to the Royal Society of Edinburgh

THE following were elected fellows of the Royal Society of Edinburgh at a meeting held on March 6: Dr. F. L. Arnot, lecturer in natural philosophy in the University of St. Andrews; Major P. C. Banerjee, Indian Medical Service; Mr. J. L. Begg, treasurer and past vice-president of the Geological Society of Glasgow; Dr. T. R. Bolam, lecturer in chemistry, University of Edinburgh; Mr. Finlay J. Cameron, general manager, Caledonian Insurance Company, Edinburgh; Mr. J. I. Carswell, lecturer in engineering, University of Edinburgh; Dr. A. M. Clark, lecturer and director of studies, University of Edinburgh; Dr. A. L. Craig-Bennett, lecturer in zoology, University of Edinburgh; Mr. E. G. Dymond, Carnegie research fellow and lecturer in natural philosophy, University of Edinburgh; Mr. J. M. Erskine, general manager, Commercial Bank of Scotland, Ltd., Edinburgh; Dr. Thomas Ferguson, H.M. medical inspector of factories, Home Office; Prof. C. Forrester, Department of Chemistry and Assaying, and acting Principal, Indian School of Mines, Dhanbad; Dr. W. H. Fowler, medical radiologist, Edinburgh; Mr. A. W. de R. Galbraith, city engineer, architect and surveyor, Christchurch, New Zealand; Mr. A. C. Gardner, chief engineer, Clyde Navigation Trust, Glasgow; Dr. R. P. Gillespie, lecturer in mathematics, University of Glasgow; Mr. T. H. Gillespie, director-secretary, Zoological Society of Scotland, Edinburgh; Mr. W. G. Guthrie, assistant in applied mathematics, University of St. Andrews; Lieut.-Col. E. E. Hume, Medical Corps, United States Army, librarian of the Army Medical Library, Washington, D.C.; Dr. D. Lees, clinical medical officer, Corporation of Edinburgh and surgeon in charge of venereal diseases, Royal Infirmary, Edinburgh; Mr. J. Macleod, manager, Glasgow Corporation Chemical Department; Prof. J. Malcolm, Department of Physiology, University of Dunedin, New Zealand; Mr. W. J. M. Menzies, inspector of salmon fisheries of Scotland, Fishery Board for Scotland, Edinburgh; Prof. L. M. Milne-Thomson, assistant professor of mathematics, Royal Naval College, Greenwich; Dr. J. Murray, Rector, The Academy, Annan; Mr. T. Nicol, lecturer in anatomy, University of Glasgow; Mr. C. W. Parsons, lecturer in zoology, University of Glasgow; Mr. A. W. N. Pillers, chief veterinary officer, Corporation of Liverpool and lecturer on veterinary parasitology, University of Liverpool Veterinary School; Mr. F. A. B. Preston, lecturer in municipal engineering, Town Planning, etc., Royal Technical College, Glasgow; Mr. J. L. Somerville, auditor to the University of Edinburgh; Dr. J. B. Tait, junior naturalist (hydrographer), Fishery Board for Scotland, Aberdeen; Mr. G. Taylor, assistant keeper, Department of Botany, British Museum; Dr. G. Timms, lecturer in mathematics, University of St. Andrews; Prof. J. M. Watt, Department of Pharmacology and lecturer in dental materia medica, University of the Witwatersrand, Johannesburg; Dr. W. F. J. Whitley, medical officer of health, Northumberland County Council; Mr. J. Wright, Kirkcaldy.

Centenaries of Priestley and Pepys

THE bicentenary of the birth of Joseph Priestley occurs on March 13, and elsewhere in this issue we print articles discussing his scientific work and describing his visits to London. A few weeks ago (NATURE, Feb. 18), reference was made to the association of Samuel Pepys with the Royal Society, the tercentenary of whose birth fell on February 23. Bicentenaries and tercentenaries of scientific interest are not of frequent occurrence and the Royal Society is marking the occasion by an "At Home" at 9 o'clock on Wednesday, March 15. With further reference to the article on Pepys Mr. Edwin Chappell, 41 Westcombe Park Road, London, S.E.3, has provided us with references showing that Pepys's birthplace was definitely in London. On this subject W. H. Whitear, in "More Pepysiana" (1927), says: "From information derived from the parish books of St. Bride's, Fleet Street, it seems to be beyond doubt that Samuel was born in his father's house in Salisbury Court". It is of interest in this connexion to give the record which appears in "Alumni Cantabrigienses" (Venn, 1924) against Pepys's name: Adm. pens. Trinity Hall, June 21, 1650. B. at Brampton, Feb. 23, 1632–3. Migrated as scholar to Magdalene, Mar. 4, 1650–1; Matric. 1651; B.A. 1653–4; M.A. 1660.

Carsten Niebuhr, 1733–1815

ON March 17 occurs the bicentenary of the birth of the famous German traveller, Carsten Niebuhr, who was the only survivor of the Danish expedition sent to examine the monuments and antiquities of the Orient in 1761. Born in the village of Lüdingworth in the Duchy of Lauenborg, Niebuhr appeared destined to follow in the footsteps of his forbears, who were small landowners. On coming of age, however, he spent his small patrimony in obtaining instruction in mathematics and by 1757 was a student at Göttingen, where he was afterwards taught the new methods of determining longitude by lunar observations by Tobias Mayer himself. Niebuhr made great use of this method in his travels in the East which occupied the years 1761–1767. After his return to Europe he commenced the publication of the account of his travels, married and, being given an official post in the town of Meldorf in Holstein, settled there. He was made a Danish councillor of State, a knight of the Daneborg and in 1802 was elected an associate of l'Institut de France. Towards the end of his life he became blind and lame. He died at Meldorf on April 26, 1815. His son, Barthold Georg Niebuhr (1776–1831), was a distinguished historian and archæologist and his grandson, Marcus von Niebuhr (1817–1860), an eminent Prussian official.

THE expedition which made Niebuhr famous was undertaken by the Danish Government at the instigation of the German orientalist, Johann David Michaelis (1717–1791), one of the first to study the biblical narratives as a part of Oriental history. The other members of the expedition were von Haven, a linguist, Peter Forskål, a Swedish naturalist, Dr. Cramer, a physician, and Bauenfeind, a draughtsman. Leaving Denmark in a warship at the beginning of 1761, the party first visited Constantinople. From September 1761 until October 1762 the travellers were in Egypt, where Niebuhr determined the positions of Cairo, Rosetta and Damietta, made maps of the Nile and measured the Pyramids. Embarking at Suez, another year was spent in the Red Sea and Arabia. Most of the members, however, had been attacked with sickness; von Haven died in May 1763, Forskål in July, Bauenfeind in August and Cramer in February 1764. Niebuhr alone was left. By then he was at Bombay. About a year later Niebuhr set out on his return journey, visiting Persia, Mesopotamia and Syria, and after seeing Cyprus, Jerusalem and Damascus, he again reached Constantinople in February 1767. Three months were spent in studying the military and civil statistics of Turkey and Niebuhr then journeyed back to Denmark via Wallachia, Moldavia, Poland and Prussia. His "Descriptions of Arabia" was published in 1772 and this was followed a year or two later by his "Travels in Arabia and the Adjacent Countries". In June 1795 a fire at Copenhagen destroyed the copper-plates for the third volume and this was not published until twenty-two years after his death.

Centenary of Hilary Bauerman, 1833–1909

HILARY BAUERMAN, who was born in London on March 16 a century ago, had an international reputation as a geologist and metallurgist. He made geological surveys in many parts of the world, acted as juror at various international exhibitions, published widely read textbooks, and at his death left his fortune for the furtherance of the study of mineralogy. His parents, who were of German nationality, came to London in 1829. At the age of eighteen years, in 1851, Bauerman became one of the seven original students of the School of Mines in London, studying under Playfair, Ramsay, Forbes, Warington Smyth and others. He also spent three years at the Freiburg Mining Academy and then on returning to England joined the Geological Survey of Great Britain. His overseas work began with his appointment as geologist to the North American Boundary Commission. In 1868 he published his "Metallurgy of Iron", in 1883 became lecturer in metallurgy at Firth College, Sheffield, and in 1888 succeeded Prof. Percy as professor of metallurgy at the Ordnance College, Woolwich. He was elected an honorary member of both the Iron and Steel Institute and Institute of Mining and Metallurgy. He died unmarried at his house in Balham on December 5, 1909, and was buried in Brookwood Cemetery.

Harrison's First Marine Timekeeper

IN connexion with his efforts to make a timekeeper which would keep time accurately at sea, John Harrison made four instruments, one in 1735, a second in 1739, a third a few years later, for which he was awarded the Copley medal of the Royal Society, and a fourth which, after being tested on a voyage to Jamaica and back lasting from November 18, 1761, until March 26, 1762, caused him to be adjudged as having won the £20,000 reward offered through the Act of Parliament of 1714. There was much delay in paying Harrison and it was laid down that all four of his time-keepers were to be handed over to the Royal Observatory. These time-keepers naturally were soon superseded by better instruments, and they ceased to be used and fell into disrepair. Some twelve years ago, however, Lieut.-Comdr. Rupert T. Gould obtained permission to recondition them and he has now completed his labours by the restarting of Harrison's first marine timekeeper, made in 1735, but not used since 1767. All four of Harrison's instruments are thus again in working order, and according to an article in the *Times* of February 28, No. 1 will be kept going in an air-tight show-case. Needless to say, this instrument bears little resemblance to a modern chronometer. It weighs no less than 70 lb. Tested aboard H.M.S. *Centurion* and H.M.S. *Orford* in 1736, however, it gave satisfactory results, and on the voyage home, when the *Orford* sighted land the reckoning by the clock showed the position of the ship to be off the Lizard, while the ordinary methods of navigation gave the ship's position as off the Start. The former proved to be the correct position.

Prof. B. Němec

PROF. B. NĚMEC, director of the Plant Physiological Institute of the Charles University, Prague, celebrates his sixtieth birthday on March 12. Prof. Němec is a well-known plant physiologist, working especially in experimental cytology and caryology, anatomy and experimental morphology, physiology of fertilisation and genetics, on symbiosis and parasitism, plant pathology, regeneration and other aspects of plant physiology. His statolith theory in plants is widely known, and also his more recent discoveries, by the use of chloral hydrate and other agents, concerning artificially induced mixoploidy and polyploidy in plants. Prof. Němec is well known to English scientific workers. In 1927 he lectured at University College, London, and he has attended many scientific meetings in England, the last occasion being the Fifth International Botanical Congress at Cambridge in 1930. Prof. Němec is a foreign member of the Linnean Society of London and also of many other learned societies of his own and other countries.

Sir Robert Hadfield and the Academy of Sciences of the U.S.S.R.

AT the luncheon given to Sir Robert Hadfield on February 28 by M. I. Maisky, the Soviet Ambassador in London, in honour of the election of Sir Robert as an honorary member of the Academy of Sciences of the U.S.S.R., it was recalled by M. Maisky that in 1831, Michael Faraday was also elected an honorary member of the Academy. Such events emphasise the internationalism of science. In Russia, since the revolution, new scientific institutes, laboratories and universities have been built, and science has made great progress; metallurgy in particular has been encouraged. In this work, Russia readily accepts foreign assistance. In his reply, Sir Robert Hadfield said that, to him, Russia is the land of Mendeléeff, whose work has been of fundamental importance in chemistry. He also spoke of the work of the well-known Russian metallurgist, the late Demetri Tschernoff, who did pioneer work on the metallography and scientific heat treatment of steel at a time when only empirical methods were used. His work, introduced to Great Britain by the late Sir William Anderson, led to the formation in 1881 by the Institution of Mechanical Engineers, of a special committee, of which Tschernoff was himself a member, to report on the heat treatment of steel; this committee is still in existence as the Alloys Research Committee. Referring to the Iron and Steel Institute, Sir Robert pointed out that there are, at present, fourteen Russian members, and he expressed the hope that this number will be increased, with the future developments of science in that country. Sir Robert Hadfield's name is, of course, associated with manganese and silicon steels, and when speaking of Russia's vast mineral resources, he naturally singled out manganese, which is much used in the production of high quality steel as well in the special alloy steels. Enormous deposits of this manganese ore occur in the valley of the Kvirila River, and Sir Robert anticipates heavy production during the next twenty years. Sir Robert concluded with a tribute to the interest in scientific development which is being shown in Russia.

Locomotion in Sponges

A NEW and valuable light was thrown on the vexed question of locomotion in sponges by Mr. M. Burton at a meeting of the Zoological Society on February 21. Mr. Burton had been asked to investigate some sponges growing on the filter-beds of the Society's Aquarium, as it was feared these might interfere with the circulation of the water. He found that even the adults were capable of moving appreciable distances to secure a more favourable area for feeding. Movement in post-larval, and young sponges, he pointed out, had been recorded on several occasions; but it was now apparent, for the first time, that even fully-grown individuals could change their position. This discovery has an important bearing on our conceptions of the biology of sponges. So far from being 'typically sedentary animals', as they are described in textbooks—the victims of chance and circumstance—it is now established that they can, or at least in some species, exercise some selection as to habitat, the movement being a directive locomotion, carried out by amœboid extensions of the ectosome.

THIS new discovery by Mr. Burton follows hard upon his observations on unattached sponges, published in the "Discovery" reports 1932, wherein it is shown that some species, and individuals of many other species, habitually lead a free existence, and are capable of being transported by currents. In this respect his observations on the sponges in the filter-beds in the Aquarium of the Zoological Gardens are particularly interesting. The individuals of this species, as yet unnamed, are very easily detached by small Crustacea, and are sufficiently buoyant to move several inches, in still water, as the result merely of a shrimp swimming by. Thus, at all ages, either by their own movement, or by being transported by currents, sponges are far from being the irrevocably fixed animals they have hitherto been supposed to be.

Australian Dairy Cattle Research Council

THE dairying industry in Australia is becoming alarmed at the prevalence of contagious abortion and contagious mastitis (mammitis) in milking herds. At the instance of the pure-bred cattle breeders of New South Wales, an Australian Dairy Cattle Research Council has been set up with headquarters in Sydney and a liaison committee in each State. It will work in close association with the Commonwealth Council for Scientific and Industrial Research and the State Departments of Agriculture, but will seek its funds from other than government sources and will be free from political control. The Australian Dairy Council, a body concerned mainly with marketing problems, has promised £2,000 a year for five years towards the cost of investigations, and other contributions are confidently expected. The work on abortion will be centred at the Glenfield Veterinary Research Station in New South Wales, while the mastitis work will be carried on in Victoria, probably with the University of Melbourne as headquarters.

Ritual at Ur

MR. C. L. WOOLLEY's first report on the excavations of the current season at Ur (*Times*, March 3), dealing mainly with a building of the little-known First Dynasty, about 3000 B.C., below the platform of Ur-Engur's ziggurat, records several features which are new, some of them by no means readily susceptible of explanation. It would appear that a ziggurat, now sheathed in the later tower, occupied the middle of a platform, in the north and east corners of which were temples of the moon god. In describing the eastern temple, Mr. Woolley directs attention to the extraordinary thickness—some fifteen feet—of the brick floor of the approach chambers which led to the open ziggurat terrace. For this, the only explanation he has to offer is that it had some religious purpose. Again, in the courtyard are two circular structures of brick, which would be regarded as bases for columns, if it were not for their great diameter of thirteen feet. The suggestion that they were intended as the bases for altars is supported by the existence nearby of a brick-built basin sunk in the floor. In an adjacent room is a circular hearth for the great cauldron in which the food of the god was prepared.

Another curious piece of ritual, if Mr. Woolley's interpretation be accepted, is brought to light in a later building, which lay over the First Dynasty temple. Here were found four pits of some size—one rectangular pit is 15 ft. by 12 ft.—sunk in the floor. Three pits, one circular and two square, had been filled with clean red earth, the fourth rectangular pit had a layer of red earth superimposed on three layers of carefully laid gypsum blocks. Mr. Woolley offers the suggestion that these pits were intended for the foundations of altars, and aptly cites the "clean earth" which the old Sumerians brought for the foundations of their temples.

Corpus of Egyptian Pottery

TENTATIVE proposals for the compilation of a complete corpus of Egyptian pottery, which were discussed at Cairo in 1931, have now taken practical shape. A scheme has been drawn up by a committee consisting of Mr. Guy Brunton, Dr. Junker of Vienna and Mr. O. H. Myers. Excavators are to be supplied with cards on one side of which a print or drawing of the pot is to be affixed, and on the other information relating to it is to be given under a number of heads. These slips, when completed, will be returned to the editor of the corpus, Mr. G. L. Harding, or, during his absence while excavating at Lachish, to Mr. O. H. Myers of the Egypt Exploration Society. The scheme of the corpus is based upon the "Predynastic Egyptian Corpus" issued by Sir Flinders Petrie in 1921, as supplemented by the additional material obtained by Mr. Brunton in his Badarian excavations. It is, however, to be continued beyond these limits to the Arab period. The co-operation has been secured of the Egyptian Antiquities Service, the French, German and Italian institutes, the Egypt Exploration Society, the Oriental Institute of the University of Chicago and nearly all the other bodies represented in the archæological exploration of Egypt.

An Experimental Air-Map

WITH the view of devising a suitable system of cartography for aviators the American Geographical Society has constructed an experimental sheet of the Pittsburgh-Cleveland area on a scale of 1 : 500,000, which is published in the *Geographical Review* for January 1933 with accompanying text by Mr. O. M. Miller. Since the drainage system is the most conspicuous guide to an airman, all water is shown in white against a background of grey, varying tints of which are used to show the surface relief. The darkest tint, contrary to custom, shows the lowest ground. White spot heights are at water-level and black spot heights at the highest points in any area. Conspicuous relief features, such as bold escarpments, are marked by black hachuring but this seems to be sparingly used. A general description of surface conditions has been attempted such as "farming country", "forested uplands", etc. Railways in black and roads in green stand out well. Red is used exclusively for objects dangerous to flying, including built-over areas, power transmission lines and oil tanks. Air ports, beacons and lighthouses are shown in yellow. Air ports are named in black, other place-names being in red. The projection used is the modified polyconical. Meridians and parallels and lines of magnetic declination are omitted from the main map and shown on a key map in the margin. The American Geographical Society invites criticisms of this sheet from aviators.

Institute of Chemistry of Great Britain and Ireland

AT the fifty-fifth annual general meeting of the Institute of Chemistry held on March 1, the Meldola medal was presented to Dr. L. E. Sutton, of Oxford, and the Sir Edward Frankland medal and prize to Mr. L. Young, of the Royal College of Science. In moving the adoption of the report of Council, the president, Dr. G. C. Clayton, remarked on the increasing activity of the Institute. Dr. Clayton pointed out that for positions of control, science alone does not suffice : the chemist must acquire much knowledge and experience and become endowed with those not less-important qualities of character, judgment and tact, which responsibility entails. Not only competition, but also discovery and invention, together with modern methods in administration and management, have contributed to the existence of conditions which are bewildering to economists and financiers. These difficulties are not new : they were present when the mechanisation of industry started but have not become more acute. It is for chemists to put our old industries in the most favourable position to meet competition, and even more to branch out into new lines, especially new industries, which, by giving employment, will absorb some of those displaced by world competition in many of the heavy industries. Prof. J. F. Thorpe was elected president of the Institute in succession to Dr. Clayton.

Recent Investigations in Nutrition

THE Minister of Health has directed the attention of county and county borough councils and other maternity and child welfare authorities to certain recent investigations and the recommendations of the Advisory Committee on Nutrition based on them (Circular 1290 : 1932 : H.M. Stationery Office. Price 2*d*. net). They deal with Dr. Helen Mackay's work on the nutritional anæmia of infancy, Prof. and Mrs. Mellanby's researches on the etiology of rickets and dental decay and Dr. Corry Mann's experiment on the effects of additional milk in the diet of schoolboys. For preventing nutritional anæmia, it is recommended that iron ammonium citrate should be added to the milk given to infants or that a dried milk containing added iron should be used. It is pointed out that severe rickets is rapidly disappearing in Great Britain, but that in some areas the milder form of the disease is still prevalent. Faulty dentition is widespread. The importance of the diet of pregnant and nursing mothers and of infants and young children containing a sufficient amount of calcium, phosphorus and vitamin D is therefore emphasised. Of these, vitamin D is the most likely to be deficient. The diet should contain fat fish such as herrings, sprats or mackerel, fish livers, egg yolk, milk and butter; if margarine is used, a brand containing added vitamins A and D should be employed. Cod liver oil and bone ash will also make good a deficiency in vitamin D, calcium and phosphorus. As regards milk, the circular urges local authorities to take every opportunity of directing attention to the merits of milk as a food and of stimulating its increased use as an article of diet for children.

Costs of Electricity Supply and Distribution

IN an endeavour to foretell the future of electricity supply and distribution in Great Britain, Mr. J. M. Kennedy and Miss D. M. Noakes have made an elaborate analysis of the statistical returns issued by the Electricity Commissioners during the last ten years. They explained the conclusions arrived at in a paper read to the Institution of Electrical Engineers on January 26. They divide the capital invested into two parts, the first giving the costs of generation and the second the costs of distribution. The results show that the distribution side of electric supply is becoming the more important. They have also reviewed the revenue derived from the sales of electricity and allocated it between generation and distribution expenses. The figures show that although the efficiency of generation has increased materially, there has been little, if any, improvement in distribution efficiency. The cost per kilowatt installed during the last ten years has diminished from £25 to £20. This is probably due to the increase in the size of the turbine and boiler units installed. If it is assumed that the percentage of spare plant required would be 83 without the grid and 20 with the grid, the amount of spare plant released in five years time would be sixty million pounds in capital. As the sales of units per pound of distribution capital increase, the ratio of the distribution costs to the total costs decreases substantially. Whilst the distribution capital is increasing at the rate of 18 millions a year, the generation capital is only increasing at the rate of 7 millions. The authors state that if the companies offered sufficiently attractive tariffs, there seems no reason why the total domestic consumption should not be twice the present total sales for all purposes. If company control is decided on, a satisfactory scheme for the regulation of prices and dividends will have to be established. Any undue increase in the average remuneration of capital will inevitably keep up the price of electricity and retard development.

Image of the Physical World in Cinematography

THE two dimensional world of light and shadow projected upon the screen of a cinema theatre is something quite unique and is essentially different from our own material world of reality. In *Scientia* for January, Mr. Torahiko Terada states that future cinema techniques could be anticipated by a careful study of these two kinds of worlds. He considers that the marvels of the cinema film depend mainly on the element of time. When the relative scale of time in the physical world and the screen world is changed we receive a shock. For example, we can see the seed of a flower growing up into full blossom in a few minutes or a bullet emerging from the muzzle of a gun accompanied by a retinue of vortices and waves. This change in the scale of time brings with it the corresponding change in every physical quantity depending on the time. When a scene of a collapsing brick chimney is projected with half the natural speed, its acceleration will only appear to be a quarter its natural value and the value of gravity will apparently be only a quarter its true value. C. F. Flammarion once dreamed of the possibility of reviewing the world's history in its reverse order by flying out of our earth with a velocity greater than that of light. The principle of relativity prohibits this, but, in the screen world, history may run easily in its reverse order. In our visual effect it is practically the perfect reversal of time. It may be considered a materialised extension of our memory. It is impossible to tell in what direction a pencil balanced on its point will fall but in the reversed film it will stand upright as nearly perpendicular as possible. On the other hand, in a reversed film we cannot tell the direction in which a billiard ball at rest on the table is going to move. The reversal of time as realised in the cinema is a straightforward denial of the second law of thermodynamics—the only law prescribing the sequence of the physical world.

New Britain

To those who believe that the present situation is a challenge to thought and that reconstruction demands fundamentally both clarity of thought and the readiness to discard preconceived ideas or established customs or institutions, when these stand in the way, the new quarterly journal, *New Britain*, should make a strong appeal. Its pages are characterised by a freedom from prejudice and a capacity for courageous and independent thought worthy of an organ aiming at national renaissance and in harmony with the spirit of the Oxford reformers to whom we owe the English Renaissance of the sixteenth century. Scientific workers will be particularly interested in the articles which attempt to assess the place of science in the new order. Mr. Gerald Heard, in his article on "Eugenics and the New Order", directs attention to the part which eugenics must play, pointing out that lack of will-power prevents use being made alike of the plans of leaders or the 'stones' provided by science. Prof. F. Soddy discusses the physical foundations of civilisation and the dangers attending a policy of drift and failure to abandon the old herd instincts of poverty and scarcity and methods of dominance based upon them. Dr. G. Scott Williamson in his article on "The Scientists' Outlook" deals particularly with the place of biological science in the new order of society and the dangers of palliatives as against a positive and thoroughgoing policy. The cultural aspects of science and its place among human values are discussed in thought-provoking essays by S. G. Hobson and Philip Mairet. The whole of the January-March issue places a welcome emphasis on the social and human values of science and the positive benefits which it might yet confer on mankind.

Voyage Around Franz Josef Land

The remarkable feat of circumnavigating the ice-girt Franz Josef Land in a small motor vessel is reported by Science Service of Washington, D.C. Prof. N. N. Subov, arguing from temperatures in the Barents Sea in recent years that the arctic branch of the North Atlantic drift was unusually warm and would reduce the amount of ice around Franz Josef Land, set out last August from Murmansk in a hundred ton motor boat with 30 days' fuel and 40 days' stores. The tour, which was made from east to west, actually took thirty-four days. A large number of soundings and salinity observations were taken. A few small corrections in the map were also made.

Announcements

Sir Richard Glazebrook, formerly chairman of the Aeronautical Research Committee, has been awarded the gold medal of the Royal Aeronautical Society.

At a meeting of the Council of the Royal Society of Edinburgh held on March 6, the following prizes were awarded: The Makdougall-Brisbane prize for 1930–32, to Dr. A. C. Aitken, of the University of Edinburgh, for various contributions to mathematics published in the *Proceedings* of the Society; Gunning Victoria Jubilee prize, for 1928–32, to Sir James Walker, for his numerous contributions to physical and general chemistry. The Bruce-Preller lecture for 1933 will be delivered by Prof. C. H. Lander, on October 23, on the subject of the utilisation of coal.

Mr. P. M. S. Blackett will deliver the G. J. Symons memorial lecture of the Royal Meteorological Society on March 15 at 7.30. The subject of the lecture will be "Cosmic Radiation".

The annual general meeting of the British Medical Association will be held in Dublin on July 25–29, under the presidency of Prof. T. G. Moorhead, regius professor of physic at Trinity College, Dublin.

A symposium on the utilisation of coal has been arranged by the British Science Guild, to be held on March 27 at the Royal Institution under the chairmanship of Mr. H. T. Tizard. The speakers include Capt. B. Acworth, Mr. S. Lacey, Eng.-Rear-Admiral W. Scott Hill and Mr. A. C. Hardy. The discussion will be opened by Dr. O. M. W. Sprague.

The Committee on Thermochemistry of the Union Internationale de Chimie proposes to publish an international table of thermo-chemical data. The Secretary of the Committee would be glad if authors who have published papers on thermochemistry within the last five years would send him two copies of their papers. Such copies should be sent to Dr. L. J. P. Keffler, The University, Liverpool.

At the annual general meeting of the Society of Public Analysts held on March 1 the following officers were elected for 1933:—*President:* Mr. F. W. F. Arnaud; *Past Presidents on the Council:* Mr. E. Richards Bolton, Dr. J. T. Dunn, Dr. Bernard Dyer, Mr. Edward Hinks, Mr. P. A. Ellis Richards, Mr. G. Rudd Thompson, Dr. J. Augustus Voelcker; *Vice-Presidents:* Mr. John Evans, Mr. H. M. Mason, Dr. G. W. Monier-Williams, Mr. George Stubbs. *Hon. Treasurer:* Mr. E. B. Hughes; *Hon. Secretary:* Mr. G. Roche Lynch.

In the paragraph in Nature of March 4 (p. 300) entitled "Photographic Analysis of Explosion Flames", the velocity of detonation is incorrectly given, through an error in typing, as "one or two metres per second"; it should read "one or two miles per second".

Under the terms of the Thomas Gray Memorial Trust, the Council of the Royal Society of Arts has awarded the £100 prize, offered in 1932 for an essay on the rescue, by another vessel, of passengers and crew of a sinking vessel, to be equally divided between Commander R. D. Binney, Chief Officer J. W. Murphy, Lieut.-Commander D. A. Stride and Lieut.-Commander J. H. Walker. For the £100 prize offered for any valuable improvement in the science or practice of navigation, nothing of sufficient merit was submitted, but an award of £50 was made to Able-bodied Seaman J. Patteson for a device designed by him and entitled "The Harmonic Constant Tide Calculator".

Seismometrical reports on the earthquakes felt and recorded in Tokyo are now issued by the Earthquake Research Institute. We have received the first two numbers dealing with the earthquakes of January–June, 1932. Each of them includes a map of the origins of the earthquakes (thirty in number) felt in Tokyo, showing that they lie in, and to the north of, the Bay of Tokyo, except four in the well-known zone that lies under the Pacific to the east of the Boso peninsula. Copies of the more important seismograms are also reproduced.

Applications are invited for the following appointments on, or before, the dates mentioned:—An assistant engineer for the River Avon (Bristol) Catchment Board—The Clerk and Solicitor to the Board, The Council House, Bristol (March 13). A principal of the Gloucester Technical College—The Clerk to the Governors, 24, Barton Street, Gloucester (March 16). An assistant borough electrical engineer and a temporary constructional engineer in the Electricity Department of the Fulham Borough Council—The Town Clerk, Town Hall, Fulham, S.W.6 (March 16). A divisional engineer (electrical) in the Department of the Chief Engineer of the London County Council—The Clerk of the Council, The County Hall, Westminster Bridge, S.E. (March 17). A lecturer in medicine at the University of Aberdeen—The Secretary (March 21). A professor of civil engineering at Trinity College, Dublin—The Secretary of the University Council (March 31). A ballistic assistant for mathematical work in relation to trajectories of projectiles—The Secretary (C.E. Branch), Admiralty, S.W.1.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Presence of a Bacteriophage for *B. salmonicida* in River Waters

EPIDEMICS of "Furunculosis of the Salmonicidæ" generally attributed to a well-defined bacterium—*B. salmonicida* (Emmerich and Weibel, 1894)—have been the cause of a high mortality among salmon and trout in England during recent years and have been difficult to deal with owing to a lack of knowledge of the epidemiology of the disease and particularly of the reservoirs of the infection during inter-epidemic seasons. The problem of following out the infection is not easy as *B. salmonicida* has no saprophytic existence in river water, in which it does not live for more than a few days, so that it is useless to attempt the isolation of the bacillus from the suspected water—even if this were a practical possibility. Moreover, the absence of sick or dead fish does not exclude the possibility of infection, as apparently healthy fish are known to act as carriers of the disease and to be capable of spreading the infection.

It seemed possible that, if the infection of fish is associated with the appearance in the water of a specific bacteriophage, this might prove a useful index for tracing the infection. This aspect of the problem does not appear to have been considered, and as no reference to a phage for *B. salmonicida* could be found in the literature, the matter seemed worth looking into, and a search was made in a number of natural waters.

Examination of the water of the Thames at Kingston during the summer of last year showed the presence of a bacteriophage highly active for *B. salmonicida*, and the phage could be demonstrated in volumes as small as 0·3 c.c. of the water. The waters of several other rivers were then tested and active phages for *B. salmonicida* were isolated from the upper reaches of the Mole in Surrey, from the Arun and the Ouse in Sussex, and from the Avon at Bath.

The water of the Arun was interesting as it yielded two apparently distinct phages. One of these, which is highly active, forms small plaques (about one millimetre in diameter) on 1 per cent agar, and continues unchanged after repeated passages with *B. salmonicida*. The other, which is less active, at first forms larger plaques (about two to three millimetres in diameter), but on repeated passages with *B. salmonicida* gives both large and small plaques.

In a sample of water from the Burn of Houlland, North Roe, Shetland, kindly sent me by Capt. S. R. Douglas, no active phage could be demonstrated in 10 c.c. of the water. Control examinations of the tap water of the National Institute for Medical Research and of the Whitestone Pond, Hampstead, showed no active phage in 250 c.c.

The recognition of an active phage as a rule gives no difficulty, the plaques formed on agar being quite definite and unmistakable. Occasionally very feeble phages are encountered which, even after repeated passage with *B. salmonicida*, show only very faint and scarcely discernible plaques on agar. Whether these feebly active strains are true salmonicida phages appears doubtful, and for the purposes in question they may probably safely be ignored.

The presence of an active phage for *B. salmonicida* in the waters of a number of English rivers is highly interesting and its connexion or otherwise with the presence of infected fish would appear worthy of investigation as, if such a connexion were established, some measure of control might at once be possible particularly in the case of hatcheries, since apparently healthy fish from these have been incriminated as responsible for the spread of the disease. In this connexion the periodical examination (for the presence of the phage) of the effluent of a hatchery supplied with phage-free water might give valuable results.

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Feb. 27.

Origin of Angiosperms

IN various notes in *Science* and in my longer studies of cycadeoids, the view is maintained that the angiosperms must be very old, and in so far as not actually discrete, related to the older flowering gymnosperms. Such views of descent relegate gnetaleans to the position of a side or blind line as suggested by Seward. The group was even held to be angiospermous by Lignier and Tison. In any event, it pictures in a lively manner some of the types of change both vegetative and reproductive which must mark the evolution of the angiosperms from homoxylous freely flowering forerunners.

Primarily, the view of a cycadeoid rather than a cordaite or conifer explanation of angiosperm derivation rested on floral evidence taken with the sharp resemblance between the cycadeoid wood and that of the Oriental dicotyledonous family Trochodendraceæ, which could be shown to have a defined relationship to the magnolia group proper. Branching and habit presented no difficulty, as the small flowered *Williamsoniella* and *Wielandiella* bridged that gap. Nor was there any marked doubt as to either the time or general mode of origin of netvenation; while *Caytonia* afforded the needed example of a very primitive, even if much isolated, angiospermous carpel with cycadeoid-like seeds.

New evidence, slow to come, had to be awaited. Here the hope of floral discovery was a slender one; while the small and primitive types of cones are as little seen as the flowers, and without more intensive methods of search or some utterly unawaited 'finds', any crucially important types of either might not appear in another fifty years. Moreover, it was obvious that the petrified record of the angiosperms is very greatly limited by an easy liability to bacterial decay. In short, the nearest points of awaited discovery became: (1) determination of wood structure in the small-stemmed cycadeoids (*Williamsoniella, Wielandiella*) as probably dependent on the materials in mid- to lower Mesozoic lignites; (2) extension of knowledge of wood structure in the Trochodendraceæ and their allies back in geological time.

Now at this point, in the latter part of 1932, a turn in the long road has been made. Fr. J. Mathiesen, in an account of fossil plants from East Greenland[1], describes from Cape Dalton, lat. 69° 30′ N., certain calcified stems of good definition which are compared with the existent *Tetracentron*, hence *Tetracentronites*.

Accompanying them there is a *Corylopsis*-like type, *Corylopsites*. The age of these most significant new woods is Palæocene-Eocene. Also, B. Sahni[2] gives a description of a so-called new genus *Homoxylon* based on a portion of a larger stem from the mid- or lower Jurassic of the Rajmahal Hills. Unfortunately the exact locality of this likewise important wood, the original of which I have seen in thin section, is not yet determined, although there is no reason to doubt its Jurassic age. Sahni compares his new genus with *Trochodendron.*

So close is the structural resemblance between these new fossils that it appears to I. W. Bailey, who in a recent letter first directed my attention to the paper of Mathiesen, as if the generic analogy were reversed. That is, Bailey would compare the Greenland fossil with *Trochodendron*, the Indian with *Tetracentron*. However this may be, both these types, though so far separated in latitude and time, are in remarkable agreement with the magnolian woods, and both present a further and most striking resemblance to the wood of such species of the cycadeoids as *Cycadeoidea Dartoni*, *C. Wielandi*, *C. Painei* (or *Paynei*), *Raumeria Reichenbachiana*, and *Bennettites* (or *Cycadeoidea*) *Gibsonianus*. In fact, were these latter woods alone known without reference to foliage or fructification, they could at most be set aside as of a family directly related to the Trochodendraceæ. Also it must be remembered that many of the cycadeoids were microphyllous, and that *Drimys* is exstipulate. The only possible doubt as to the main position of the new Greenland and Indian types thus arises from the close agreement of the wood structures with those of such old and obviously specialised types as the cycadeoids just cited.

Comparison of the homoxylic (vessel-less) angiosperms with cycadeoids depends much on the region next the pith. *Drimys*, with thick-walled ray cells, and clear transition from well-defined scalariform to pit wood, is here the fundamentally important type; while consideration of the heteroxylic *Liriodendron* further shows how the simpler scalariform elements are transformed into vessels. The cycadeoids of reference here are those amongst the many species studied which in occasional specimens or parts of such in exceptional preservation show both ray and tracheidal features in full detail. Thus in *Cycadeoidea Dartoni* there is seen the most remarkable transition from scalariform to pit wood, exactly comparable to that figured by Mathiesen in the Greenland *Tetracentronites*. Again, in the radial sections from the mid-region of the United States National Museum type, *Cycadeoidea Paynei*, preservation of both ray and tracheidal elements is perfect, the structure-parallel of both with *Tetracentronites* complete. Likewise these features are seen in an equal beauty of preservation and identity amongst the very different, small-flowered, free-fruiting and geologically much younger cycadeoids of the Mesaverde of the San Juan Basin of New Mexico. In all the foregoing, the scalariform-pit wood transitions, and the thickened ray cells are present. That is, this structural agreement of the cycadeoids with the Trochodendraceæ, and in part with the magnolias, is in evidence far and wide from Jurassic, down into later Cretaceous times. It is too impressive to be without bearing on the origin of the angiosperms.

Much of this bettering of illustration and comparison has depended on more persistent and improved sectioning methods. Thus Mathiesen mentions that he found etching the Cape Dalton calcified materials with hydrochloric acid an advantage. This I also found an aid in clearing polished surfaces of calcified stems from the Isle of Wight. Also, silicified stems containing distinct amounts of residual carbon as in *Raumeria* and other cycads such as the *C. nigra* from Colorado, may be effectively etched with hydrofluoric acid where the requisite thinness and clearness is difficult to reach by the simple thin-section method. Followed by careful washing and covering, such sections supplement the gelatine pulls.

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[1] *Meddelelser om Grønland*, Bd. 85, No. 4.
[2] *Pal. Ind.*, 20.

Upper Pressure Limit in the Explosive Chain Reaction between Hydrogen and Oxygen

WHEN the two pressure limits, between which the normally slow combination of hydrogen and oxygen, at, say, 540° C., becomes explosive, were first discovered, the existence of the lower limit was attributed to the deactivation of chain carriers at the wall of the vessel, and that of the upper limit to deactivation in the gas phase. Unless one or other of the deactivation processes is vigorous enough to balance a branching of the chains, explosion occurs. The theory of the lower limit has since been confirmed by detailed investigation, and shown to account for the facts more or less quantitatively. Theories which make the upper limit depend upon the vessel wall have also been suggested, but further experiments have shown that the assumption of some form of gas phase deactivation cannot be dispensed with.

Hitherto, no really quantitative theory about the detailed nature of this deactivation has been worked out. The first tentative idea was that it depended upon the mutual destruction of hydrogen peroxide molecules concerned in the propagation of the chain. The well-known theory of Haber that hydrogen atoms and hydroxyl radicles play the most important part in the chain naturally suggests that the deactivation might consist in the recombination of such atoms or radicles: for this a three-body collision would be advantageous.

The purpose of this note is to state that further experiments, shortly to be published, lend what seems to be practically conclusive support to the view that the upper limit is governed by ternary collisions in the gas phase. The particles which are deactivated or recombine in this process must be much more massive than pairs of hydrogen atoms.

The following simple theory accounts quantitatively for many of the facts about the upper limit. Let X and Y be two kinds of atom or molecule which collide in the course of a chain and let there be a certain probability that at such a collision the chain branches. If, however, any third molecule arrives while X and Y are associated together, then deactivation occurs. Equating rate of branching to rate of deactivation we have:

$$k[\mathrm{X}]\,[\mathrm{Y}] = Z_1\,[\mathrm{X}]\,[\mathrm{Y}]\,[\mathrm{H}_2] + Z_2\,[\mathrm{X}]\,[\mathrm{Y}]\,[\mathrm{O}_2] + \\ Z_3\,[\mathrm{X}]\,[\mathrm{Y}]\,[\mathrm{M}]$$

M representing an inert gas present. The *Z* factors are proportional to the collision frequencies of the complex X Y with hydrogen, oxygen or the inert gas respectively. From this it follows that at the limit $Z_1[H_2] + Z_2[O_2] + Z_3[M]$ is a constant. Experiment shows, in agreement with this, that at the limit in the absence of an inert gas, $[H_2] = C - b[O_2]$, and also that on addition of inert gas there is a linear decrease in the partial pressures of hydrogen and oxygen. The influence of helium is considerably greater than that of argon on account of its much greater speed, and consequently greater Z_3 value. Similarly, the constant b, which equals Z_2/Z_1, is much less than unity.

The value of Z can be shown to be proportional to $\sigma^2_{XYM} \Big/ \mu^{1/2}_{XYM}$ where $\mu = \frac{m_{XY} \cdot m_M}{m_{XY} + m_M}$, m_M, etc. being the molecular weights and σ_{XYM} the sum of the molecular diameters of the complex X Y and the colliding molecule M; similarly for Z_{H_2} and Z_{O_2}.

To allow the high speeds of hydrogen and of helium compared with oxygen and argon to have the influence in the calculation which experiment shows them to have in practice, the value of m_{XY} must not be too small. Thus X Y must be much heavier than a pair of hydrogen atoms. For the purposes of a preliminary calculation, we have assumed X Y to be an activated complex of H_2 and O_2, which has a finite probability of branching unless hit by a third molecule. Using the molecular diameters given in the table in Tolman's "Statistical Mechanics", we find that helium should have 1·77 times the effect of argon, while the experimental value is about 1·6. Moreover, the ratio of the Z values for hydrogen and oxygen gives the calculated value of the constant b as 0·39, compared with an experimental value of 0·325. Having regard to uncertainties in the molecular diameters, these agreements are very close, and show that the relative speeds of the different molecules principally determine the variation of the upper limit. Thus the theory of gas phase deactivation of fairly massive complexes in ternary collisions is strongly supported.

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Feb. 11.

Structure and Division of Somatic Chromosomes in *Allium*

THREE divergent views have been expressed regarding the structure of chromosomes. Pfitzner in 1882 suggested that a chromosome is made up of a row of granules embedded in an achromatic or less chromatic matrix. About the same time, Baranetzky found a spiral structure in certain stages in the meiotic cycle of the chromosomes of *Tradescantia virginica*. Vejdovsky (1912) has termed this spiral the chromonema. The chromonema theory conceives of a continuous, filiform, spirally coiled chromatic element in an achromatic matrix. The alveolar theory foreshadowed by van Beneden and worked out by Grégoire and his pupils contemplates the homogeneous chromosomes of the metaphase becoming during the following stages a honey-combed structure by the appearance in it of numerous alveoles. The supporters of this view assume that a longitudinally aligned central series of alveoles would account for the origin of the split in each chromosome.

The exact nature of the behaviour of chromosomes both in mitosis and in meiosis, as well as their rôle in heredity, can be understood only if their real structure is known. A study of the structure of the chromosomes of *Allium* has been undertaken under the kind guidance of Prof. R. Ruggles Gates, with the view of solving some of these problems. A preliminary account of the results so far obtained by cytological observations and the use of wire models is given below.

(1) At the early metaphase each chromosome is seen to be composed of two spirally coiled chromonemata and the duality of this spiral has been observed in all stages of the mitotic cycle.

(2) The spiral is coiled in opposite directions in the two arms of the chromosome, the null point of the spiral being the attachment constriction of the chromosome.

(3) This form of double spiral permits of the separation of the chromosome into two by a simple uncoiling. This commences at the ends, as observed in *Allium*, but conceivably in some forms it may be initiated by the pull of the spindle fibres at the point of constriction.

(4) This unwinding causes rotation in the two arms of the chromosome; it may be possible that, as a result of this rotary motion in each arm of the chromosome, longitudinal cleavage is initiated in each chromonema at the metaphase stage.

(5) The separated chromonemata (daughter chromosomes), which now present a double spiral structure in each, remain parallel until they are finally pulled apart to the opposite poles of the spindle.

The doubleness of the anaphase chromosomes is clearly seen and the twisted appearance of these is due to slight loosening of the double spiral, which has been observed by Hedayetullah[1] in *Narcissus* and by Miss Perry[2] in *Galanthus*. The threads of this spiral retain their spiral structure in the subsequent stages of the mitotic cycle. The different appearances presented by the chromosomes in these stages are mainly due to the compact or loose nature of the double spiral. The dual threads remain closely associated together until their final separation at the next metaphase.

Further work on this subject is in progress and it is hoped that a detailed account may be published at a later date.

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Feb. 7.

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[1] Hedayetullah, *J. Roy. Mic. Soc.*, 51, 347–386.
[2] Perry, *J. Roy. Mic. Soc.*, 52, 344–356.

Synthesis of Protein by Green Plants

IN green plant tissues, the relation of protein synthesis to light has long presented puzzling features. It is known that many such tissues can synthesise protein in the dark if carbohydrate supply is abundant. Normally, however, protein accumulation in leaves appears to take place chiefly or solely in the light. In the case of an alga, *Chlorella*, Muenscher showed that approximately equal amounts of protein were accumulated if the algal cells were grown in either dark or light on a glucose medium containing nitrate. Muenscher's cultures were continued over a long time, and they simply show, therefore, that protein synthesis approaches the same *equilibrium* point in the dark as it does in the light.

Using the same strain of *Chlorella* as Muenscher (that of Hopkins and Wann), we have found that the alga grows and synthesises protein much more rapidly in the light than in the dark. Thus of a number of pure cultures (inoculated with the same number of cells and grown on a glucose medium containing ammonium nitrate), some were taken for analysis to represent the original condition, others were kept for three days (*a*) in the dark or (*b*) in continuous light. These yielded on analysis, as mgm. per culture, the following:

	Dry Weight	Total Nitrogen	Protein Nitrogen	Gain in Protein Nitrogen
Original	84·4	2·83	2·56	
Dark	112·1	3·42	3·05	0·49
Light	193·4	5·60	4·97	2·41

It thus appears that the *velocity* of protein synthesis is much greater (five times) in the light, though the final equilibrium is similar in either light or dark, if sufficient carbohydrate is available. This conclusion would also satisfactorily interpret the available data for the higher plants.

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Insects and Micro-Climates

IT is well known that when water is exposed to dry air, evaporation takes place and the liquid becomes cooler than its surroundings; when a dish of water is placed in still air at 30° C., the temperature of the water is sometimes considerably lower than that of the air. The amount by which the water is cooler depends on the humidity of the air, for the lowering of the temperature is directly proportional to the rate of evaporation, which is governed by the saturation deficiency. In our experiments, when the air in the room has a humidity of 78 per cent, then the temperature of the water is 27·9° C., and when the humidity is 40 per cent, then the temperature is 22° C.

The temperature of the air immediately above the water in the dish has approximately the same temperature as the water. Experiments have shown that *Culex fatigans* is killed by an exposure to 41° C. for an hour, and it is suggested that its habit of resting in damp situations has enabled this insect to survive in countries where the shade temperature is frequently considerably above 41° C. Many insects which are found in these situations are probably attracted there by the lower temperature and not by the high humidity.

The large fall in temperature due to evaporation means that the conditions to which many insects are subjected are even more different from those measured by standard meteorological methods than is usually realised. In experiments with a number of different insects, we have shown that exposure to dry air is usually more rapidly fatal than exposure to moist at the same temperature. At first sight this would imply that, for any given temperature, the higher the humidity the more favourable the conditions for these insects; but it is possible that the effect may be the reverse, for the high atmospheric humidity will prevent evaporation and raise the temperature to which the insect is actually subjected. For example, in air at 35° C. with a relative humidity of 90 per cent, the temperature of the water would be 33° C. (assuming that 2·5 mm. saturation deficit gave a reduction of 1° C. which was the amount found in our experiments). If, however, the air was at 40° C. and had a relative humidity of 10 per cent—conditions which would prove rapidly fatal to many insects—then the water would only be at 20° C.

We should like to direct the attention of entomologists to these observations, in the hope that they will study the climatic conditions of the air in wells, over collections of water in rot-holes and in other places where insects are found resting.

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Feb. 20.

Triphenylmethyl Derivative of Vitamin C

1 GM. of ascorbic acid (vitamin C) was dissolved in 5 c.c. of pyridine and 1·4 gm. triphenylchloromethane were added. After standing for two days at 30° C. the solution was diluted with chloroform, shaken out twice with water and dried with anhydrous sodium sulphate. The solution was evaporated *in vacuo*, the syrupy residue dissolved in a little benzene and precipitated with petrol. The precipitate was ground up in a mortar under 2 per cent acetic acid, dried, and reprecipitated from benzene as above.

Trityl-ascorbic acid is a white amorphous powder, easily soluble in chloroform, benzene, alcohol and alkali, insoluble in ether, practically insoluble in water and petrol. It begins to colour at 80° C. At 130° it melts with blackening and decomposition. Its specific rotation is + 30° (*c.* 3·0). Its percentage composition was carbon, 71·1 and hydrogen, 5·41; calculation for the formula $C_{25}H_{22}O_6$ gives carbon, 71·73 and hydrogen, 5·3.

The mono-acetone-ascorbic acid did not give a trityl derivative. The acetone-ascorbic acid and the triphenylchloromethane were recovered unchanged.

It follows that vitamin C contains a primary OH group, which is involved in mono-acetone-ascorbic acid in the formation of the isopropylidene group. Owing to the presence of a carboxy group, we may also conclude that vitamin C is not an aldehyde and the CO group is present as ketone.

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Feb. 6.

Indophenol Reducing Capacity of Lemon Juice and its Fractions in Relation to Vitamin C Activity

MR. DANN[1] is labouring under a misapprehension in interpreting the results of my paper[2]. My figures show that if the reducing capacity of the various lemon juice fractions be interpreted in terms of fresh decitrated lemon juice, eighteen guinea-pigs receiving daily doses equivalent to 2 c.c. (reduction value 8–10 c.c.), eighteen receiving doses equivalent to 1·5 c.c. (reduction value 6–8 c.c.), thirty-six receiving doses equivalent to 1 c.c. (reduction value 4–6 c.c.), seventy-two animals in all (tested usually three in a group), died of apparently uncomplicated scurvy within 30–40 days. It need scarcely be stressed that young guinea-pigs do not vary in biological response to anything like this extent but *always* survive much longer than 30–40 days, even if they are not fully protected, on daily doses of 1–2 c.c. or even less of lemon juice. This fact invalidates Mr. Dann's inferences.

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[1] Dann, NATURE, 131, 274, Feb. 25, 1933.
[2] Zilva, *Biochem. J.*, 26, 1624; 1932.

Vitamin C and Ascorbic Acid

Messrs. Birch, Harris, Ray and Dann have summed up in Nature of February 25 (p. 273) the arguments for believing that vitamin C and hexuronic (ascorbic) acid are identical. In the course of their observations they refer to "Ostermalt" as having been shown by their chemical method to contain an amount of ascorbic acid that should cause it to protect guinea-pigs from scurvy in a daily dose of 3·3 gm.; no figure was apparently available to the authors enabling them to compare this conclusion with an actual biological assay.

In further substantiation of the authors' views that ascorbic acid and vitamin C are identical, I may be permitted to state that Ostomalt, to which they presumably refer, as manufactured in these Laboratories for the last six years, contains a proportion of concentrated Californian orange juice ? The amount of this juice present in Ostomalt is such as to give the equivalent of half its own volume of fresh orange juice to the product. 3·3 gm. of Ostomalt occupy a volume of about 2·5 ml., and the figures given by Birch, Harris and Ray for the protective dose of orange juice are 1·2, 1·5, 1·9 ml. It will therefore be seen that the results obtained by their titration method are in good agreement with the equivalent of fresh orange juice present in the product.

A short while ago an independent laboratory, carrying out tests for an official body, found by biological assay that Ostomalt contained an amount of vitamin C that was "in very fair agreement with their [the manufacturers'] claim that the product contained antiscorbutic vitamin equivalent to half its volume of fresh orange juice".

It would therefore seem that the chemical estimation of the vitamin C present in this product, which is primarily a mixture of malt solids, concentrated orange juice, and cane sugar, with certain other vitamin supplements, is in substantial agreement with direct and indirect biological assays, affording further confirmation for the views of Birch, Harris, and Ray as to the identity of vitamin C and ascorbic acid.

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Feb. 27.

An Inhibitor of the Antimony Trichloride Test for Vitamin A in Cod Liver Oil.

It has been shown[1] that traces of substances like furan, indol and skatol inhibit strongly the intensity of the absorption band of vitamin A with antimony trichloride at 620 mμ. In cod liver oil, there must be such an inhibitor, because after saponification a much stronger Carr and Price reaction is obtained with the unsaponifiable fraction.

Attempts to isolate this inhibitor by means of different soaps in various solvents; vacuum distillation; bromination and debromination; and cooling down to low temperature in different solvents, proved to be unsuccessful. However, I have succeeded in isolating it in the following way: Cod liver oil for medical purposes (pale yellow coloured) is saponified, acidified and the mixture of acids dissolved in five volumes of petroleum ether (b.p. 60°–80°). After drying with anhydrous sodium sulphate the solution is vigorously shaken up with 1/10 volume of diluted sulphuric acid (5 volumes of 96 per cent sulphuric acid + 2 volumes of water). The sulphuric acid layer contains the inhibitor and is poured out into a large volume of cold, saturated sodium sulphate solution. This mixture is extracted several times with petroleum ether. After evaporation of the solvent, the resulting oil is distilled and boils at 180°–210°/1–2 mm. This oil is dissolved in petroleum ether and again shaken out with sulphuric acid. The resulting oil, a pale yellow viscous substance, boiled at 203°/1 mm. From 1 litre of cod liver oil about 2½ c.c. was obtained.

The inhibiting power (measured by means of a Zeiss stuphometer with the *S* 61 filter) is four to five times as large as that of indol. The substance readily absorbs bromine and gives a strong orange yellow colour with tetranitromethane. The iodine value (Wijs) and bromine value (Kaufmann) depend on the time of reaction and excess of the reagent. Iodine values varied from 205 to 392, and bromine values from 166 to 364.

Molecular weight determination gave 332 (titrated as a mono-basic acid). Analysis gave as a formula $C_{21}H_{36}O_{3}$. Qualitative tests for sulphur and nitrogen (Lassaigne) were negative. Catalytic hydrogenation (platinum catalyst) showed absorption of about 4 atoms of hydrogen per molecule. The hydrogenated product has lost the inhibiting power, and gives no colour with tetranitromethane (bromine value after 5 minutes reaction = 0).

However, it may also be pointed out that the inhibiting power of a substance is not due to its unsaturation alone, because specially prepared, very pure, unsaturated fatty acids (oleic, linoleic acid) do not show any inhibiting power. Impure fatty acids (oxidised) give a red Carr and Price reaction; thus in presence of vitamin A there results a mixed colour, but no inhibition will be seen by spectroscopical research.

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Jan. 30.

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[1] Nature, 128, 495, Sept. 19, 1931.

Dissociation of Nitrous Oxide in the Glow Discharge

In a recent paper, Kueck and Brewer[1] describe experiments made on the dissociation of nitrous oxide in the 'glow' discharge. Using a special disposition of electrodes which eliminates anode glow and positive column, they find, with fields of the order of 2,000 volts/cm., over a pressure range 2–5 mm., that the initial decomposition rate is practically independent of the initial pressure. Similar results for both nitrous oxide and ammonia have been described by Hinshelwood and Hutchinson[2], who, using a method which gives essentially the integrated dissociation throughout all parts of a normal glow discharge, state that for weak discharges the absolute amount of decomposition tends to be independent of the initial pressure. They observe, however, that for more intense discharges "the amount of decomposition becomes proportional to the pressure, i.e., the percentage decomposition is now independent of the initial pressure". This they term the "unimolecular state". Unfortunately, they give little data as to the potentials employed.

I have, for some time, carried out experiments on nitrous oxide under slightly different conditions, namely, in the high-frequency discharge (frequency approximately 100 kc.) in long tubes (*c.* 70 cm.) of 4 cm. diameter with external electrodes very close to the ends. Under these conditions, the glow is distributed almost uniformly throughout the gas. In the earlier experiments, damped high-frequency current from a spark oscillator was employed. Fields of average peak intensity ranging from 100 to 400 volts/cm. were applied, with initial pressures ranging from 0·1 to 3·0 mm., and a specially devised membrane gauge[3] enabled any one dissociation to be followed almost to completion.

The results were in substantial agreement with those of Hinshelwood and Hutchinson. At the lowest intensity of discharge, there was a definite tendency for the initial rate to vary little with the initial pressure, but at the highest potential difference employed there was a small pressure range in which the dissociation was sensibly unimolecular. The transition from one state to the other is shown strikingly by plotting the half-value period T, against the initial pressure p_0, for a given potential difference. For low potential difference, T increases rapidly with p_0, but the curve shows a slight inflection, which becomes more pronounced at higher potential differences and finally develops into a flat portion of curve parallel to the p_0 axis over an appreciable range of p_0. But even at points well removed from this unimolecular region, a given dissociation as a whole is found to be better described by a unimolecular law than by any other law of integral order, although the velocity constant is now pressure dependent.

In a further series of experiments (in collaboration with Mr. C. H. Noton) a valve oscillator was used, current measurements were made, and an improved discharge tube and gauge allowed the dissociation to be followed in greater detail. Measurements were made well away from the unimolecular region. It was found that for a brief period (3–4 sec.) after initiation, the dissociation rate increased, rapidly attained a maximum, and then proceeded 'normally'. The current varied in a similar manner, reaching maximum shortly after $(dp/dt)_{\max.}$. A number of considerations militate against its being ascribed to possible selective adsorption on the walls in the initial stages, and the effect appears to be real. A similar and much larger effect has also been observed with nitrogen pentoxide. Further experiments are in progress and are being extended to ammonia. It is hoped to publish shortly details of the experiments already made.

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Jan. 31.

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[1] *J. Phys. Chem.*, **36**, 2395; 1932.
[2] *Proc. Roy. Soc.*, A, **117**, 131; 1928.
[3] *J. Sci. Instr.*, **7**, 217; 1930.

Relative Intensity of Spectral Lines in Indium and Gallium

DURING 1932, work has been carried on in this laboratory on the measurement of the relative intensity of spectral lines in the above elements. The amount of material available was very limited, consisting of a small quantity of metallic indium and a little gallium chloride, both kindly supplied by Prof. Fawsitt, of the Inorganic Chemistry Department of this University. All this material has now been used up, and thus the results are published at this stage.

Results are given for the doublet $2p_{3/2}-2s_{1/2}$ and $2p_{1/2}-2s_{1/2}$ for each element. The wave-lengths of these lines are 4511 A. and 4102 A. respectively for indium and 4172 A. and 4033 A. respectively for gallium. Measurements of other doublets of the same series had not been successful by the time the material had all been used up.

The photographic methods introduced by Prof. Ornstein were followed fairly closely. The spectra were produced in an arc with silver-tipped copper poles, which gave a clear spectrum in the required regions. In the case of indium, a button of the metal alloyed with lead was placed on the lower pole, while for gallium the chloride was packed into a hole drilled in the lower pole. The potential applied to the arc was in one plate 100 volts and in the others 250 volts, while the arc current was 3–4 amp. A set of density marks, taken with a small incandescent lamp calibrated photographically by means of a standard lamp, was put on each plate. A reducer was used to divide each spectrum into two parts so that two sets of readings might be obtained from each spectrum. These two sets agreed within experimental error. The exposure time for the arcs varied, and was not always the same as that for the density marks, but there is no corresponding variation in the results.

When an arc was taken using pure indium, a reversal effect was obtained. To investigate the effect of this, alloys of lead and indium were made up, containing different proportions of the two metals, varying from 1 In : 10 Pb to 1 In : 500 Pb, and used in different plates. These alloys were prepared by melting the lead and indium together in a crucible under tallow to prevent oxidation. The mean results obtained with different alloys showed no regular variation, so that apparently any reversal effect is negligible at these concentrations. With the same object, some of the gallium arcs were taken with pure gallium chloride and others with a mixture of approximately equal parts of the chlorides of zinc and gallium. Both gave the same results within experimental error.

The results for indium are given below. The first column gives the proportions by weight of indium to lead in the alloy used in the plate. The intensity ratio given in the third column is that of the line of longer wave-length. The ratio a_1^2/a_2^2 is obtained from I_1/I_2 by multiplying the factor $(\lambda_1/\lambda_2)^4$, a_1 and a_2 being the amplitudes of the virtual oscillators given by the equation $I = a^2v^4$. The last row in the table gives the mean of all the results for different plates and concentrations.

In./Pb.	No. of Readings.	Mean I_1/I_2	Mean a_1^2/a_2^2	Mean error in I_1/I_2
1/10	5	1·66	2·42	0·11
1/33	3	1·51	2·21	0·06
1/33	3	1·73	2·53	0·09
1/33	7	1·64	2·39	0·05
1/100	4	1·47	2·15	0·06
1/500	7	1·61	2·35	0·04
	29	1·62	2·35	0·09

The corresponding results for gallium are given below. The last row again gives the mean of all the results.

No. of Readings.	Mean I_1/I_2	Mean A_1^2/A_2^2	Mean error in I_1/I_2
8	1·36	1·55	0·07
8	1·36	1·55	0·07
16	1·36	1·55	0·07

The mean values of a_1^2/a_2^2 obtained for this pair of lines for indium and gallium, namely 2·35 and 1·55 respectively, may be compared with the value 2·58 obtained by Prof. Vonwiller[1] for the corresponding pair for thallium.

In conclusion, I wish to thank Prof. Vonwiller, who suggested the work, for his continued help and advice.

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Dec. 21.

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[1] *Phys. Rev.*, **35**, 7, 802; 1930.

Absorption Bands of Iodine Vapour at High Temperatures

I HAVE investigated the absorption of iodine vapour in a tube of 26 cm. length at temperatures above 800° C. over the region 2900–5000 A. and have observed the appearance of a continuous absorption band with a sharp limit at 3425 A. on the long wave side. With increasing temperature the intensity of this band increases and at 900° C. a new absorption band appears with the long wave limit at 3252 A. At about 1050° C. both bands extending from 3425 A. to 3000 A. change in appearance, showing on the continuous background many close bands. These are extremely diffuse and it was impossible to decide whether they are genuine band heads or due to fluctuations of intensity in the continuous spectrum.

The table below gives the temperature t and the vapour pressure p at which each kind of spectrum appears.

Limit of band.	Broad continuous band appears at		Narrow bands appear at	
	t	p in mm.Hg.	t	p in mm.Hg.
3425 A.	775°	80	1050°	760
3252 A.	885°	760	1050°	760

If the vapour has the temperature 1050° C., the broad continuous band at 3252 A. appears first at a pressure of 150 mm. mercury. Similar experiments were also made with a shorter absorption tube of 13 cm. length and it was found that the length of the tube does not affect the appearance.

The following are peculiar features of these absorption bands: (*a*) an abrupt limit on the red side which in the region investigated is independent of the temperature between 800° and 1050° C; (*b*) the maximum of the absorption lies close to the red edge of the band, namely, at 3425 A.; another less prominent maximum lies at 3252 A.; (*c*) the bands extend down to about 3000 A.

Oldenberg[1], investigating the influence of foreign gases on ultra-violet fluorescence of the iodine vapour, observed these bands in emission. He found that with increasing pressure of foreign gas the continuous band at 3460 A. first increases and then spreads into many narrow diffuse bands. The same phenomenon was observed by Cario and Oldenberg[2] in electric discharges through narrow capillary tubes in iodine vapour and by E. Hirschlaff[3] in fluorescing vapour at high temperatures. The narrow absorption bands show an exact agreement with those measured by Oldenberg between 3252 A. and 3000 A.; in the region 3425–3252 A., however, the bands quoted by Oldenberg were not all found and those actually observed show an irregular increase of $\Delta\nu$ with the wave-length.

The appearance of these bands in the absorption spectrum seems to contradict Oldenberg's suggestion ascribing their origin to the recombination of iodine ions $I^+ + I^- = I_2 + h\nu$ (*Ionenvereinigungsleuchten*).

In connexion with the observed absorption band limit at 3425 A. (800°–1050° C.) it is of interest to note that according to Oldenberg's observation in fluorescence (20° C.), the band limit appears at 3460 A., whereas Hirschlaff finds it at 3439 A. also in fluorescence (640° C.).

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[1] O. Oldenberg, *Z. Phys.*, **25**, 136; 1924.
[2] G. Cario and O. Oldenberg, *Z. Phys.*, **31**, 914; 1925.
[3] E. Hirschlaff, *Z. Phys.*, 75–325; 1932.

Neutrons

I HAVE obtained the following result, from a unified field theory. Two particles, of charges e, E, and masses m, M exert on each other, apart from the usual electrostatic force, also a 'gravitational' repulsion with a potential

$$\frac{e^2E^2}{4mc^2}\,\frac{1}{r^2}$$

if $M >> m$.

If this result is correct, it could account for the existence of neutrons. An electron and a proton are held together in a neutron by combined attractive and repulsive forces which are in statical equilibrium. The size of a neutron is thus $r \simeq 1{\cdot}4 \times 10^{-13}$ cm., and the binding energy is $mc^2 \sim 5 \times 10^5$ electron-volts.

Chadwick's values for the size and binding energy of a neutron are 10^{-12}–10^{-13} cm. and 10^6 to 2×10^6 electron-volts.

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Feb. 12.

Preservation of Fossil Bones

REFERRING to the note in NATURE of January 28, p. 129, I have found that the safest and simplest method of hardening permanently and without discoloration the tusk and osseous fragments of the great Mammalia (mammoth and rhinoceros) recently found in the west of Scotland is repeatedly to baste the pieces with a strong solution of gum Dammar. This should be done after the object has become rather dry but before any warping occurs.

The method of treatment will, however, depend upon the condition of the relics. The Scottish pieces which I have handled are now exhibited in Kelvingrove Museum, Glasgow, and were all found in a very wet and spongy condition, 15–25 ft. under grass-level and in the laminated gravels of the old raised terrace of the Kelvin River, some eight miles east of Glasgow, at about 170 ft. O.D.

Had the pieces been allowed to remain without treatment, disintegration would now have been complete; with an incalculable loss to science.

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Feb. 4.

Research Items

Ancient and Modern Man. In opening a discussion on man's kinship with the primates at the Royal Anthropological Institute in November last (*Man*, No. 9, 1933), Dr. S. Zuckerman offered the suggestion that the existing classification of man is irrational, preventing a convincing evolutionary interpretation of the remains of fossil man available for study. Dr. Zuckerman reviews the evidence on which he bases his suggestion in the *Eugenics Review*, vol. 24, No. 4, and arrives at the tentative conclusion that archaic types and modern man fall into two easily definable groups, the sub-family Palæanthropidæ comprising such forms as *Pithecanthropus*, Peking man, and Neanderthal man; and the sub-family Neanthropidæ consisting of types like modern man and the men of the upper palæolithic. Generic status has been assigned to *Sinanthropus*, yet taking the ten Neanderthal skulls selected for contrast by Prof. Davidson Black, they show intra-specific differences of linear dimensions often greater than those regarded as generic differences in the family Hominidæ. Again, in the main distinguishing feature of Neanderthal skulls, the small flattened sagittal area, *Sinanthropus* corresponds not only to Neanderthal man, but also to Rhodesian man and *Pithecanthropus*. Differences in the vertical planes in which certain breadth measurements of the brain-case fall have been taken as differentiating *Pithecanthropus* and *Sinanthropus*, yet as important a difference in one of the breadth measurements differentiates all Neanderthal men from modern man; but here it is regarded as specific only. The difficulties which arise from the unequal significance attached to the peculiarities of Neanderthal man, *Sinanthropus* and *Pithecanthropus*, point to one of two conclusions—either *Sinanthropus* should be included in the genus *Pithecanthropus* or the accepted classification of all extinct Hominidæ should be revised.

'Iberomarusian'. In *L'Anthropologie* (T. 42, Nos. 5–6) MM. E. G. Gobert and H. Vaufrey discuss the application of the term 'Iberomarusian' coined by A. Barbin (1869–1932) to distinguish an industry discovered by him in the cave of La Mouillah, near Marnia (Oran). This culture he regarded as closely related to the upper palæolithic of south-east Spain, described by Siret. The most characteristic feature of the culture is its microlithic industry, though it has been regarded as distinctively palæolithic. Other Iberomarusian sites have been identified in eastern Morocco, Oran, Algiers and Constantine. A distribution map published in 1914 shows that Capsian and Iberomarusian are mutually exclusive, the former being confined to the southern Tunisian area and adjacent province of Constantine, while the latter belongs to the littoral area of the tells. The authors now describe two sites which mark the extremes of the Iberomarusian culture in east and west. These are Ouchtata (Tunisia) and El-Hank and Aïn Rahmane (Casablanca). The description of the finds on these sites establishes the character of the culture with greater precision, while the El-Hank site indicates the close relation of the Iberomarusian with the underlying Aterian, which is a late survival (also found elsewhere in Africa) of a technique of Mousterian origin. Tentatively it is suggested that the Iberomarusian is the littoral facies of the continental Capsian and that in the steppe region the typical Capsian overwhelmed and took the place of the Aterian, which on the littoral lies at the base of the Iberomarusian. This last is mesolithic rather than palæolithic. But even if the Iberomarusians and Capsians possessed industries of widely different facies, they were nevertheless of one and the same race, that of Mechta el-Arbi. The evidence being against the African affinities of the upper palæolithic of south-east Spain, 'Iberomarusian' might possibly be replaced by 'Oranian'.

Spread of Eskimo in Greenland. It is rare in modern times to find an extension of the area occupied by primitive people. There are abundant signs that in the past all the ice-free border of East Greenland was occupied by wandering Eskimo but the last seen on the north-east coast were on Clavering Island in 1823. In 1894 the Danes founded the Eskimo settlement of Angmagssalik in the south-east and in recent years have been successfully promoting further settlement. In a lecture to the Royal Geographical Society on February 6, Capt. E. Mikkelsen described some of these efforts and discussed the habitability of the coast, especially the Boisseville Coast between Kangerdluksuak and Scoresby Sound. A new colony of 85 Greenlanders, transferred from Angmagssalik, was established at Scoresby Sound in 1924. This colony flourished and now numbers 150. Conditions in the vicinity point to the possibility of its extension. Seals, walrus, narwhals, foxes, bears and birds are abundant. The musk-ox also occurs in fair numbers but these are protected at present. It is essential, however, if the colonies are to thrive, that the seal and walrus shall be protected from European hunters not only along that coast but also farther to the north, whence the ice-floes come south with the seals. The Boisseville coast is less attractive but the number of bears show that seals are abundant. Eskimo have already used this coast in the past and it is the aim of the Danes to establish along it a line of contact between the Scoresby Sound colonies and Angmagssalik.

Abnormal Chitons. Iw. Taki (*Mem. Coll. Sci.*, Kyoto Imp. Univ., Ser. B, vol. 8, No. 1, 1932) records eight specimens of Japanese chitons with less than the usual number (eight) of shell-plates. Examples are described in which reduction to five, six or seven plates has occurred, with subsequent regulation of form among them, including cases in which a shell-plate partly atrophied has fused with other plates. Specimens with a reduced number of shell-plates tend to have a shorter body-length than normal. The author brings together previous records of hypomeric and coalesced shell-plates—35 with seven plates, 9 with six plates, 2 with five and 2 with three plates. There is no case recorded in which the number of plates exceeds eight.

Bast-Sap. Prof. H. H. Dixon (*Sci. Proc. Roy. Dub. Soc.*, 20 (N.S.), 487–494) has described experiments which, it is claimed, elucidate the path and mechanism of translocation in plants. It is now suggested that the sieve tubes can permit a mass flow of solution. Experiments are described which show that under external pressures of 3 atmospheres, a solution introduced into the phloem moved at a rate of 7–8 cm. per hour. An incision into the phloem, without penetrating the xylem, frequently causes, especially in angiosperms, an exudation of a minute amount of liquid (0·1–0·2 c.c. from a 1 mm. slit in 30 min.) which contains organic matter (up to 12 per cent sugar). This mechanism of phloem exudation, which is now attracting considerable attention, is supposed to reveal the composition of the moving fluid and also to demonstrate the reality of mass flow. The osmotic pressure of the exudate varied from 13 to 35 atmospheres. Experiments on *Fraxinus excelsior* show that the sap from a higher level is always more concentrated than from a lower. This difference (maintained chiefly by the supply of carbohydrates at a high level and their removal at a lower) causes the flow along the sieve tubes. It is suggested that the theory offers adequate explanation for other recent results on ringing experiments.

Uses of Rice Grass. The history of the remarkable polyploid plant *Spartina Townsendii* has recently been described by J. Bryce ("The Economic Possibilities of Rice Grass", *J. Roy. Soc. Arts*, 81, No. 4176, Dec. 2, 1932) who shows how its habit of growth is specially suitable for use in land reclamation and the prevention of coast erosion. Many striking instances of its wonderful power of colonisation are given, and experiments on the best methods for the utilisation of this power are described. In Holland, where the Kreekrak Polder was rising at the rate of a foot in five years, *Spartina* caused the level to rise nearly five feet in a similar time. Rice grass is also a palatable food for farm animals, especially sheep, and large yields of produce can be obtained. It can be grown in districts where salt abounds, either on the seashore or in the neighbourhood of artesian wells the waters of which are heavily charged with saline matter.

Phylogeny of Ammonites. A monograph on the Lower Triassic ammonites of North America (U.S. Geol. Surv. Prof. Paper 167, 1932, pp. 199, pls. 81) by the late J. Perrin Smith is the last of a series of five works on Carboniferous, Permian and Triassic ammonoids published from 1903 onwards. The Lower Triassic ammonites of North America have been found in Idaho, California, Nevada and Utah, and comprise 117 species belonging to 32 genera. Only three of the genera are peculiar to North America and it is probable that these will eventually be found elsewhere. Three families, the Xenodiscidæ, Meekoceratidæ and Hungaritidæ, are almost certainly immigrants from the Indian region, while the Proноritidæ and Thalassoceratidæ are probably native to the American region. *Tirolites* is an immigrant from the Mediterranean region. The Celtitidæ appear in America, on one side, and in Albania on the other, and probably originated in the Arctic province. Of the five zones which have been recognised in the Lower Trias, only three are found in North America, the zones of *Meekoceras*, *Tirolites* and *Columbites*. The systematic part of the work is fundamentally phylogenetic and is based on the stratigraphical succession of adult forms, and on the evidence of ontogeny. The author is convinced that the late Palæozoic and early Mesozoic ammonoids repeat in their ontogeny their ancestral history with a fair degree of exactness, for they had not been greatly affected by unequal acceleration of development and scarcely at all by retardation or arrest of development. In the Jurassic and Cretaceous Ammonites recapitulation is not so distinct, because the disturbing factors (acceleration, retardation, and the development of cænogenetic characters) have combined to obscure the record. By the application of these methods the author traces the various genera of Lower Triassic ammonites back to their Palæozoic ancestors, but for the details of this phylogenetic study the work itself must be consulted.

Lowering of the Japan Sea Floor. Prof. H. Tsuya has described some pebbles recently brought up from the bed of the Japan Sea (*Earthq. Res. Inst. Bull.*, vol. 10, pp. 864–875; 1932). They were collected at various points on a submarine ridge, the Yamato Bank, that runs northwards from the south-west coast of Japan, and at depths of 1,500–2,000 ft. The pebbles are rounded or subangular, and vary in size from mere sand-grains to more than 20 in. in length. All of them have the general petrographic characters common to their respective rock-types now exposed in the Japanese islands. It is improbable, from their wide distribution, that they are ballast dropped from passing ships, and, from the size of some of them, that they were transported by currents so far from the present shores. There remains the alternative that the sea-floor on which the pebbles lay was, in recent geological time, either a land-surface or a shallow sea near the shore, and the author directs attention to papers by Dr. H. Yabe (*Bull. Imp. Acad.*, vol. 5, pp. 167–169, 430–433; 1929), in which are described two submarine shelves round the coast of Japan, furrowed by valleys that are continuations of those on the present land. From the depth of the margin of the lower shelf, Dr. Yabe infers that the Japanese islands were at no very distant date joined to the continent and that they have since then subsided by not less than 2,360 ft.

Further Calculations of Electron Scattering by Atoms. In a recent paper (*Proc. Roy. Soc.*, Jan.) Massey and Mohr amplify their previous work on the scattering of electrons by atoms. The wave-mechanical problem involves in general the distortion of the incident electron wave by the atomic field, exchange of electrons between the atoms and the incident beam, the disturbance of the atomic field, and the distortion of the scattered wave by the new atomic field. The distortion of the scattered wave might be expected to be large in the case of inelastic collisions as the spread of the atomic field and the wave-length of the electron are both increased by the collision, and the present paper represents an improvement on previous work in that this distortion is included as well as the effect of exchange of electrons. The calculations have been carried out for the elastic scattering in hydrogen and helium and for electrons which have excited the 2^1P and 2^3P states of helium. The new curves for the atomic cross-sections do not differ very significantly from the old, and at low velocities the theory predicts too large a cross-section. This behaviour is probably due to the neglect of the disturbance of the atomic wave functions by the incident electrons. The theory applied to inelastic scattering by heavy atoms shows that the angular distribution of scattering is similar to that for elastic collisions, except at low velocities and large angles, and this is in accord with observation.

Radioactivity of some Rare Earth Elements. The radioactivity of samarium has been reported by Hevesy and Pahl (NATURE, 130, 846, Dec. 3, 1932) and this observation has been confirmed by Libby and

Latimer (*J. Amer. Chem. Soc.*, Jan.), who have also found the elements lanthanum and neodymium to be radioactive. The activities of lanthanum and neodymium are not appreciably screened by 0·07 mm. of aluminium, whereas that of samarium is largely, if not completely, screened, indicating that the activities of the former are mainly of the β-type whilst that of samarium is due to α-rays. Two different samples of neodymium, one sulphate and the other oxalate, showed a molar activity about 2·5 times that of potassium; the lanthanum activity was eight times that of potassium and the samarium about three times. Very pure gadolinium sulphate gave a negative result. It is considered that the radioactivity of the three rare earth elements is due to the presence of unstable isotopes, but the possibility of the presence of actinium as an impurity in the lanthanum and neodymium samples has not been excluded.

Steam-Jet Operated Air Ejectors. Steam jets have long been used for increasing the draught through boiler furnaces and in connexion with vacuum brakes on trains, and in 1902 Sir Charles Parsons introduced his 'vacuum augmenter' for increasing the vacuum in a condenser of a turbine plant. Since then, single-stage and two-stage ejectors have come into common use in power stations. The theory of the appliance is not a simple one and the success attained with various types has been mainly due to prolonged experimental investigations. Some of these investigations have been carried out in engineering laboratories. One such inquiry was described by Dr. A. H. Church in a paper published in 1927 in the *Journal* of the Royal Technical College, Glasgow, while on February 17, Mr. F. R. B. Watson in a paper read to the Institution of Mechanical Engineers dealt with a recent investigation made in the engineering laboratory in the University of Bristol. His paper was entitled "The Production of a Vacuum in an Air Tank by Means of a Steam Jet". The objects of his investigation included the study of the effect of the distance from the steam nozzle to the diffuser, the explanation of the action of the parallel throat in an ejector and the determination of the ratio of steam to air at different vacua and under different initial steam pressures. A description of the plant used was given and the paper was illustrated with photographs, curves and tables. The paper is printed at length in *Engineering* for February 24 and March 3, the latter issue also containing a report of the valuable discussion which followed the reading of the paper.

Astronomical Topics

The Reinmuth Planet, 1932 *HA*. This is the planet that can approach the earth within 3 million miles, and that actually came within 6 million miles last May. Dr. G. Stracke has published a very careful discussion of its orbit (*Astr. Nach.*, No. 5919) including the effect of planetary perturbations. Unfortunately, the accurate observations cover a range of only 18 days, April 27–May 15. The discovery plates on April 24 had such long trails that they could not be measured with exactness. The planet was photographed at Johannesburg on May 7; combination of this position with northern ones indicated a parallactic shift of about 100″, giving a good determination of the distance from the earth. The following are Dr. Stracke's elements:

Epoch 1932 Apr. 25·0 U.T.			q	0·644597
M	319° 59′ 1·60″		e	0·5662417
ω	284° 51′ 48·73″	1932·0	a	1·4860743
☊	35° 50′ 19·59″		Period	1·8116 years
i	6° 25′ 10·85″		n	1958·6005″
			T	1932 July 7·5

The period just exceeds that of Eros, 1·761 years; Eros has still the shortest known period among the minor planets. But both Eros and *HA* have shorter periods than Mars (1·881 years). *HA* makes a still closer approach to the orbit of Venus than to that of the earth, so it is subject to considerable perturbations from these planets.

Dr. Stracke fears that there may be great difficulty in recovering *HA*; but efforts will doubtless be made in the spring of 1934, though its distance from the earth will be considerably greater than in 1932. It will not receive a permanent number or a name until it is recovered, as the present range of observations is too short for this purpose.

Annuaire Astronomique Camille Flammarion, 1933. This attractive handbook, published annually by the Observatory of Juvisy, contains the usual calendar information with diagrams of the planetary paths among the stars, and descriptive articles about them. The article on Pluto states that "it is certainly not greater than the Earth, or even than Mars". The last four words cannot be taken as certain; many of the estimates of its mass exceed that of Mars.

In the diagram of the tracks of future solar eclipses that of 1945, total in Norway, has been inserted; it was accidentally omitted last year. The table of elements of periodic comets is carefully kept up to date by M. F. Baldet. It includes the observations of the first half of 1932. The stellar tables include explanations of the spectral types, and details of magnitude, distance and motion. There are light-curves of some variable stars and details of novæ. The list of the latter includes 20 somewhat doubtful ones before 1572 and 41 certain ones observed since that date; 31 of the latter are between 1892 and 1925 showing that the rate is about one a year.

A cryptic sentence on page 185 seems to need revision: enumerating the various motions of the earth, it concludes: "Enfin, un quatorzième mouvement . . . a été découvert en 1916: le déplacement . . . du système sidéral tout entier, . . . à la vitesse de 600 km./sec., vers . . . la constellation du Capricorne."

The Observer's Handbook for 1933. This volume, published by the Royal Astronomical Society of Canada, contains, besides the usual calendar matter, diagrams of the paths of the planets through the stars, with some details about Pluto (the earliest photograph of which was taken in 1914, and not 1919 as stated). There are useful notes on the phenomena of each month and a table giving particulars of the positions, spectral type, distance, absolute magnitude and motion of the 260 brightest stars: another table does the same for the 35 stars nearest to the sun. A few stars occur in both tables. There is also a list of occultations of stars by the moon visible at Ottawa in 1933.

Virus Diseases[*]

THE term 'virus', formerly used in a much wider sense, has recently been given a special and restricted application. Viruses are distinguished from such long-recognised agents of infection as bacteria by their small dimensions, putting many of them beyond the limit of clear visibility by the highest powers of the microscope, and allowing them to pass through filters fine enough to retain the smallest ordinary bacteria; and by the fact that they cannot be cultivated on ordinary, non-living media. The work of Pasteur and Koch initiated an epoch of investigation on the relation of visible bacteria to different infections, so that the first clear recognition of the existence of ultramicroscopic and filterable infective agents came only in the last decade of the nineteenth century, and the present century has seen the rapid progress of investigations on their nature. The viruses first recognised—those of mosaic tobacco disease and the foot-and-mouth disease—are still far beyond the range of the most advanced microscopical methods, and, if studied by themselves, might still be regarded as living contagious principles in solution. A large number of diseases of man, animals and plants are now known to be due to infection by viruses, and methods now available have shown that the infective units of the different recognised viruses cover a wide range of dimensions.

Ordinary bacterial filters only indicate that the sizes of the infective units of viruses are below a certain maximum. Ordinary microscopical methods may show that the particles of a particular virus are beyond the range of resolution, or that it contains particles which can be brought just into the range of visibility (about $0 \cdot 2\ \mu$) when loaded with a dye. Neither of these methods, however, enables the natural sizes of the units of different viruses to be determined for comparison.

Conventional microscopical methods revealed the association between infection with certain viruses and the appearance in the infected cells of the relatively large structures termed 'inclusion bodies'. These could not represent the virus in the form in which it passes a bacteriological filter. In 1904, however, Borrel described extremely minute bodies in suitably stained films from the juice of tissues infected with fowl-pox, and similar 'elementary corpuscles' were later found in material from vaccinia (by Paschen) and from *Molluscum contagiosum*. The important discovery was made in recent years (Goodpasture) that the large 'inclusion bodies' consist of 'elementary corpuscles' closely packed in a structureless matrix, and that a single washed inclusion body will transmit a virus infection. The evidence for identification of the elementary corpuscles as the organisms of these viruses has been strengthened by their agglutination with sera from animals immune to the corresponding virus (Ledingham).

In the absence of any possibility of testing their identity with the virus by artificial culture, there remained that of comparing the sizes of fresh, unstained elementary corpuscles from different viruses, as measured on photographs of critical microscopic images, obtained with ultra-violet rays of a suitable wave-length (Barnard), with the sizes of the infective units of the corresponding viruses, as measured by differential filtration through graded collodion membranes, of which the effective pore dimensions could be determined with sufficient accuracy (Elford). The comparison of the measurements of visible corpuscles, on one hand, and infective units on the other, has now been completed in the case of several viruses, and has shown a correspondence so satisfactory as to leave no room for doubt that the elementary corpuscles are the organisms of these viruses.

Filtration measurements of the infective units of other viruses, however, show that they are much too small to be brought within the range of any microscopical method which can be foreseen. In the case of the virus of foot-and-mouth disease, the units appear to have a diameter as small as about $10\ m\mu$, only about twice that of the molecule of oxyhæmoglobin. The difficulty of regarding such minute particles as self-propagating organisms has given rise to the suggestion that they are toxic principles, reproduced by the perverted metabolism of cells which they infect. A similar suggestion has been made to account for the reproduction of the virus-like lysins or bacteriophages which infect bacteria. In both cases, however, such a theory seems to be incompatible with recent evidence dealing with specific immunity to such viruses.

Specific treatment of viruses is still limited to the production or re-inforcement of a naturally acquired immunity. Recent success in that direction with dog-distemper (Laidlaw and Dunkin) has aroused in some minds a hope of similar success with a human disease, such as influenza. The analogy fails, unfortunately, through lack of an animal species in which the influenza virus can be propagated and made the subject of deliberate experiment, and of evidence of a strong and lasting immunity to its attack. The facts, however, that methods for the exact study of viruses are only now becoming available, and that knowledge of their properties is of recent and rapid growth, justifies a general hope of much wider success in dealing with the diseases which they produce.

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[*] Substance of a lecture entitled "Ultramicroscopic Organisms and the Troubles which they cause", delivered by Sir Henry Dale, Sec. R.S., at Bedford College, London, on March 1.

Geology in Great Britain

THE "Summary of Progress" of the Geological Survey of Great Britain for 1930 has been issued in the three parts that have now become customary, the first[1] being devoted to the annual reports of the Geological Survey Board and of the Director and to the routine work carried out during the year under review, while the others contain papers on subjects of special interest. Forty-four maps were published with seven English and three Scottish memoirs, some of which have already been noticed in our columns (NATURE, vol. 127, 574, April 11, 1931).

Of the Scottish memoirs, that dealing with Ardnamurchan deserves special mention. It is a work of unrivalled geological interest that will always rank as one of the greatest contributions to the literature of Tertiary igneous activity in the British Isles. This memoir has already been individually reviewed (NATURE, 128, 619, Oct. 10, 1931). It is noteworthy that work has been resumed in the Ardnamurchan-Moidart area of the West Highland district. The survey of Unst has been completed and a summary report accompanied by a geological map is supplied by H. H. Read.

An important statement in the report of the Survey petrographer refers to the Cheviot granite: "It has been established beyond reasonable doubt that the normal Cheviot granite is a soda-rich granophyric granite almost devoid of ferromagnesian constituents, and that the so-called augite-granite owes its unusual characters to the incomplete assimilation of basic material derived from the andesitic lavas".

In Part 2[2] there are five papers on various aspects of Carboniferous geology and palæontology. Sir John Flett contributes a stimulating paper on a teschenite sill in Fife, and W. Q. Kennedy gives a critical discussion of the parent magma of the British Tertiary Province. The results of a gravitational survey over a region of magnetic anomaly in Leicestershire are recorded by W. F. P. McLintock and J. Phemister. In Part 3[3] these authors also describe a magnetic survey over the Lornty Dyke in Perthshire, while A. F. Hallimond deals with a similar survey over the Pentland Fault near Portobello. Stanley Smith continues his invaluable work on corals, describing here his investigation of certain Upper Carboniferous species from Glamorganshire. The zonal sequence of the non-marine lamellibranchs of the Upper Carboniferous of Yorkshire is dealt with by D. A. Wray and A. E. Trueman.

Discussing the correlation of the British and French Upper Coal Measures, R. Crookall concludes that our highest Coal Measures are the equivalent of the Upper Westphalian of the Continent. Bernard Smith gives records of a suite of borings through the glacial drifts of the northern part of the Isle of Man. Sir John Flett returns to the problems of differentiation presented by teschenite-picrite sills, dealing here with a sill encountered in a boring at Blackness on the south shore of the Firth of Forth. The petrography and stratigraphical position (Caradocian) of the keratophyric lavas of the Tweed valley in Peeblesshire are described by R. J. A. Eckford, M. Richie and D. Balsillie. In an important paper on a carbonate rock associated with cromaltite in the Loch Borrolan laccolith, J. Phemister reaches the conclusion that the so-called limestone is not of sedimentary origin, but represents a carbonated ultrabasic rock; the demonstration removes the only piece of direct evidence which has been advanced in favour of assimilation of limestone in this alkali intrusion.

The memoir on the Whitehaven and Workington district[4] covers part of the western fringe of the Lake District and the lowland mining and agricultural areas extending to the Solway Firth and the Irish Sea (Sheet 28). The region owes its economic importance to its wealth of coal and iron ore lying close to the seaboard. The memoir is the first complete description of the area to be published, and in view of the great variety of geological formations and tectonic episodes, it constitutes a noteworthy contribution to British geology. Many problems of general interest are discussed. The Skiddaw slates are found to have closer analogies with the Levis shales of Quebec than with their equivalents in Wales and Shropshire. The Ennerdale granophyre is shown to be a stock rather than a laccolith and to be of probably Caledonian age. Seven chapters are devoted to the Carboniferous formations. A very large number of shaft and boring sections have been examined and surface mapping has been supplemented on an unusual scale by observations underground. The red Permo-Triassic beds present many fascinating problems. There is a remarkably full sequence of glacial deposits, three episodes, each comprising an advance and retreat of the ice, having been established. The second glaciation, due to combined Lake District and Scottish ice, has left a widespread record of powerful erosion, ground moraine and drumlins, eskers, kames, deltas and overflow channels. Other chapters deal with recent deposits and economic products, and special mention must be made of a masterly chapter on the structure of the district.

The Brampton district[5], portrayed on Sheet 18, is an attractive area stretching east from Carlisle to near Haltwhistle, which includes parts of the Alston block, Tyne gap, Edenside and the Carlisle plain. The rugged crags of the Whin Sill, surmounted eastward from Greenhead by the Roman Wall, are of interest both to geologists and archæologists. The Carboniferous rocks naturally claim most attention and they are of special importance in forming a link between Northumberland and West Cumberland. Although the Midgeholm coalfield is now almost exhausted, appreciable reserves of the Little Limestone coal still exist. A noteworthy account of the rhythmic cycle of deposition characteristic of the Yoredale Series is given. In the New Red Sandstone Series of the western half of the district the only mineral of value is the gypsum used for plaster making. Glacial drifts mask the outcrops of the solid rocks over widespread stretches, and the chapters that deal with the waxing and waning of the glaciers and with the development of the river systems are of more than usual interest.

The Manchester memoir[6] is descriptive of Sheet 85, which covers an area extending west to Tyldesley, north to Bolton, Bury and Rochdale, and east to Oldham and Hyde at the foot of the Pennines. It thus embraces much of the highly industrialised area of South Lancashire. Although the region has been heavily exploited in the past, there are still considerable resources of coal within easy reach. Apart from chapters on the Permo-Triassic rocks, tectonics and glacial geology, the memoir is almost wholly devoted to the stratigraphy, palæontology, structure, and economics of the Coal Measures. Investigation of fossil bands which mark important horizons has been extended over the whole field, and wherever exposures are available has afforded a more exact correlation of coal seams than has hitherto been practicable. The important fossils from each horizon are figured so that their recognition in newly exploited areas should not be difficult.

The official descriptions of the geology of the Scottish Highlands north of Inverness are completed with the publication of the memoir on central Sutherland[7]. An area of nearly nine hundred square miles, mapped on Sheets 108 and 109 of the geological map of Scotland, is covered. The region includes the peaks of Ben More Assynt, Ben Loyal, the Griams, Morven and Scaraben and is very thinly populated, being mainly devoted to deer forest and shootings. Geologically, however, it is of great interest since all the great formations of the Northern Highlands fall within its limits. The opening chapters describe the scenery and physical features and summarise the geology. Short chapters dealing with the Lewisian, Torridonian and Cambrian on the west and with the Old Red Sandstone and Jurassic on the east link up the memoir to those already issued. The main features, however, are the descriptions of the vast spread of Moine rocks, of the gneisses of Lewisian type that occur as apparently integral parts of the Moine Series, and of the great masses of granite that have veined and permeated the Moine, producing great injection-complexes that are of outstanding petrographic significance.

A series of memoirs is to be published under the general title: "*Economic Geology of the Fife Coalfields*". The first of these[8] to appear deals with the western part of the county, around Dunfermline, and includes the important coal-mining districts of Valleyfield, Blairhall, Tounhill, Saline and Blairenbathie. The introductory chapter provides a summary of the geology and a brief account of the physical features and of the Old Red Sandstone rocks of the district. This is followed by detailed descriptions of the Calciferous Sandstone and Carboniferous Limestone Series, and special attention is given to the important coalfields of Limestone Coal Group age. The structure is very complicated, as there are many faults, intrusions of igneous rocks, and locally, considerable thicknesses of volcanic ash. To aid in the elucidation of the relations, more than 1,600 boring records have been collected and annotated. Later chapters deal with the superficial deposits and with such economic materials as building stone, road metal and fireclay. The memoir includes a map and a glossary of mining terms.

The memoir devoted to chemical analyses[9] is the outcome of a generally expressed desire that the great number of chemical analyses of British rocks and minerals made by the Geological Survey should be collected and classified, and published in a separate volume. Analyses of igneous and metamorphic rocks and isolated minerals to the number of 611 have been dealt with. They have been brought together from Survey memoirs and other official publications, and additional analyses, hitherto unpublished, have been drawn from the records of the Laboratory. So far as practicable, they have been tabulated under rock-groups; each rock being named and its microscopical characters briefly described. Full details of localities are given, and reference is made in each case to the Survey map and the memoir dealing with the district concerned. The methods usually employed in the chemical analysis of rocks are indicated.

University and Educational Intelligence

EDINBURGH.—On March 2 Sir Ian Hamilton was installed as the Lord Rector, received the honorary degree of LL.D. and delivered his rectorial address, the last part of which was a plea for the control of civil air-craft. "Insist on the Disarmament Commission bringing some concrete act, in regard to the air service, home with them. If we refuse to grapple with this air problem, now in its infancy, within two or three years it will have got quite beyond human control, and then, where's all the use of your learning."

LEEDS.—Mr. A. V. Williamson, head of the Department of Geography in the University, has been elected to the newly-established readership in geography.

LONDON.—The title of reader in experimental physiology in the University of London has been conferred on Mr. H. P. Gilding, in respect of the post held by him at University College.

The following degrees have recently been conferred: D.Sc. degree in anatomy on Mr. Francis Davies, reader at King's College, for three publications on anatomy; D.Sc. degree in physiology on Mr. E. W. Fish, recognised teacher at St. Mary's Hospital Medical School, for a published work entitled "An Experimental Investigation of Enamel Dentine and the Dental Pulp" (Bale, Sons and Danielsson, Ltd., 1933); D.Sc. (Economics) degree on Hans Raj Soni (London School of Economics) for a thesis entitled "Indian Industry and its Problems" (vol. I—"Factors in Industrial Development") (Longmans, 1932).

ST. ANDREWS.—At a meeting of the University Court on March 3 it was intimated that Mr. Frank O. Salisbury has offered to paint and present to the University, a replica of his portrait of Dr. Edward Harkness, founder of the Commonwealth scholarships and the Pilgrim Trust and the benefactor of the University of St. Andrews and many other educational institutions. In addition to the original portrait (which remains in the possession of Dr. Harkness) a replica was painted by Mr. Salisbury for Harvard University. The portrait represents Dr. Harkness in the robe of the LL.D. of St. Andrews. The Court agreed to accept Mr. Salisbury's generous offer.

WALES.—The Council of University College, Cardiff, has received under the will of the late Prof. C. M. Thompson a capital sum of £5,000, the income from which is to be expended on books and periodicals relating to chemistry or certain allied branches of science.

WITH reference to the announcement made in NATURE of February 18, p. 248, of the Lady Tata Memorial scholarships for research in blood diseases, we are informed that the total number of scholarships has been increased to four, and that they are open to candidates from all nations, including India. Nominations in respect of Great Britain and the Dominions will be made by the advisory committee in London to the trustees in Bombay. Applications may be addressed to Dr. H. S. Patel, c/o Messrs. Tata Ltd., Capel House, 62 New Broad Street, London, E.C.2, to Prof. A. Vacha, Calvinstrasse 27, Berlin, N.W.40, or to the Lady Tata Memorial Trustees, c/o Messrs. Tata Sons Ltd., Bombay House, Bruce Street, Fort, Bombay.

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[1] "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1930." Part 1. Pp. iv + 92 + 2 plates.

[2] *Ibid.* Part 2. Pp. vi + 90 + 9 plates. 2*s.* net.

[3] *Ibid.* Part 3. Pp. vi + 92 + 9 plates. 2*s.* net.

[4] "Geology of the Whitehaven and Workington District (Explanation of Sheet 28)." By T. Eastwood, E. E. L. Dixon, S. E. Hollingworth, and B. Smith. Pp. xvii + 304 + 8 plates. 6*s.* net.

[5] "Geology of the Brampton District (Explanation of Sheet 18)." By F. M. Trotter and S. E. Hollingworth. Pp. xi + 223 + 9 plates. 5*s.* net.

[6] "Geology of Manchester and the South-east Lancashire Coalfield (Explanation of Sheet 85)." By L. H. Tonks, R. C. B. Jones, W. Lloyd, and R. L. Sherlock, with a Chapter on the Palæontology by W. B. Wright. Pp. xv + 240 + 7 plates. 5*s.* net.

[7] "Geology of Central Sutherland (Explanation of Sheets 108 and 109)." By H. H. Read. Pp. viii + 238 + 5 plates. 4*s.* 6*d.* net.

[8] "Economic Geology of the Fife Coalfields. Area I (Dunfermline and West Fife)." By D. Haldane and J. K. Allan, with Contributions by C. H. Dinham. Pp. viii + 158 + 2 plates. 3*s.* 6*d.* net.

[9] "Chemical Analyses of Igneous Rocks, Metamorphic Rocks and Minerals compiled from the Records of the Geological Survey." By E. M. Guppy, with Petrological Descriptions by H. H. Thomas, and Notes on the Methods of Analysis by F. R. Ennos and R. Sutcliffe. Pp. x + 166. 3*s.* 6*d.* net.

(London: H.M. Stationery Office.)

Calendar of Nature Topics

The Débacle

March 15.—During the winter, the rivers of Canada, Russia and Siberia are firmly frozen, and the break-up of the ice in spring is an imposing phenomenon, which is termed the 'Débacle'. In southern Canada and southern Russia it begins about the middle of March, but is progressively later in higher latitudes, not coming until May or even, in the extreme north of Siberia, not until June. It lasts from a fortnight to six weeks, during which time the drifting ice masses often form jams, blocking the rivers and causing floods. In the northward flowing rivers of Siberia, in which the upper courses melt first and pour their waters over the still frozen lower reaches, this process is accentuated, and the whole country becomes impassable; Irkutsk, for example, is isolated for a month in May.

Manuring of Grass-Land

In the "Farmer's Kalendar" written by Arthur Young in 1771, we find the top-dressing of grass land set down as a suitable operation for February. The manures that he recommends for this purpose are distinctly nitrogenous and he says, "some of them, particularly soot and malt dust, will show themselves the first heavy showers, in a finer green than the rest of the field; but your proof of it does not arise from fine greens but weight of hay".

More than a century and a half afterwards, the use of quick-acting nitrogenous artificials is now gradually coming into grass-land management as a means of obtaining this vigour which the older writers had observed. Careful work on the effect of early nitrogen on pasture has shown that more rapid growth of grass takes place in spring and the herbage is of particularly high feeding value if grazed while it is still young. In regard to nitrogenous manures, we are more favourably placed than farmers in the last years of the eighteenth century.

We now have available unlimited supplies of active nitrogen compounds at unusually cheap prices, and modern practice exploits their crop-producing power to the full. Owing to the greater activity of present-day nitrates and ammonium salts, as compared with the organic sources of nitrogen on which Arthur Young and his contemporaries had to rely, the time of application to grass-land is now somewhat later than formerly and much of the nitrogen used for the 'early bite' goes on the land in March.

Return of the Gannets

Generally about the end of February or the beginning of March, the gannets (*Sula bassana*) make an appearance at the Bass Rock in the Firth of Forth, from which Linnæus named them, after their short winter absence on the high seas. Exceptionally early returns have taken place in the second week of January. Early in April the first eggs will be laid, and very soon thereafter the whole breeding colony of more than eight thousand individuals will be in full activity. A census made in 1929 revealed the presence of 4,047 nests, and adding to the nesting pairs the numbers of birds which were nestless on account of the destruction of their eggs by herring gulls, the adult breeding gannets of that year numbered 8,294 individuals. In addition, there was an unestimated group of immature and other non-breeding birds which spent most of their time at sea. The shore leave or breeding season of gannets is a generous allowance, for they remain at the Bass from March until the young are able to fly, the general departure taking place in October; but often a rearguard remains to convoy the last fledged of the young, so that in 1929, four hundred birds still hung about the Rock in early November and the last group of about fifty left only on November 13.

Migration of Caribou in Canada

In recent years the caribou or woodland reindeer of Canada have increased in numbers, at any rate in the western part of their range, and with increasing numbers they have reappeared on their old migration routes. Great herds had been observed by Mr. W. H. B. Hoare, during his survey of the Thelon Game Sanctuary in 1928–29, to congregate during the winter in the neighbourhood of Great Slave Lake and Artillery Lake. Early in March a distinct migration northwards began. The moving herds assumed a wedge-shaped formation, the thin edge leading, and during the six weeks which they occupied in passing a particular place, the wedge expanded from a few hundred yards in width to an army which extended from Artillery Lake to Thelon River.

The order of precedence was definite: the wedge tip consisted of a narrow column of old bulls, and during the first two weeks nothing but bulls appeared in the widening phalanx. Then followed two weeks when bulls and cows were about equal in numbers, and the final two weeks saw cows and yearlings make up practically all the remainder of the herd. The migration was a slow movement in extended order, for the animals fed as they marched. During these winter movements the cows travel farther than the bulls, penetrating, towards the south, the fringe of the timber lands, and towards the north passing on to the safe areas selected for fawning. So that the bulls may be said to confine their wanderings to the central part of the caribou range, whereas the cows, starting in the rear of the migration, soon overtake the bulls and pass on through their ranks to the farther north.

Low Temperatures cause Mortality amongst Marine Fishes

The exceptionally protracted spell of cold weather in the early part of March 1929, which was responsible for the mortality amongst shallow-water molluscs already referred to in this Calendar (Jan. 28), also affected the inhabitants of deeper water. The heat stored by the ocean during the summer months is dissipated slowly, so that the northern sea reaches its lowest temperature in March, and in its shallower reaches in the North Sea is, therefore, particularly susceptible to unusually low air temperatures. Such an area lies off the Dutch coast, where the influence of chilled water from Continental rivers is also felt. As a consequence, the catches of bottom fish made during March and April 1929 showed an exceptionally large proportion of dead individuals. Soles seemed to have suffered most, but brill, dabs, plaice, cod and even crabs were brought up dead, and the chafed condition of the surface of their bodies showed that the mortality was not due to the operation of the trawl. Although the earlier reports came from the area off the coast of Holland, similar conditions were found to exist in limited areas to the east and west of the main region, so that in all an area about 200 miles long and 50 miles broad was affected to some extent.

J. R. Lumley and G. T. Atkinson showed that the hydrographical conditions were exceptional, for although the temperature of the North Sea along the shores of Scotland and northern England did not vary much from that normal for the season, the temperature of the Continental shores fell below 0° C. and considerable quantities of ice were present on the coasts of North Germany and Denmark (*Jour. du Conseil*, vol. 4, Dec. 1929). Other happenings, apparently due to the same cold spell, were the increase in the numbers of flounders caught and the presence of numbers of small sturgeon in the southern North Sea, as if they had been forced to migrate from the rivers to the sea by the intense cold.

Societies and Academies

LONDON

Royal Society, March 2. T. M. LOWRY and H. HUDSON: Optical rotatory power. (4) Rotatory dispersion of bornyl and menthyl xanthates, especially in the region of absorption. The fundamental problems of the form of the absorption bands in organic compounds, and of the relationship between absorption, circular dichroism and rotatory dispersion in optically-active compounds, are discussed on the basis of experiments made with the bornyl and menthyl xanthates and dithiourethanes prepared and studied by Tschugaeff. The experimental curves are symmetrical on a scale of wave-lengths. The ratio of the dichroism to the absorption of unpolarised light is approximately proportional to the frequency throughout the greater part of the first band, but on the side of shorter wave-lengths the circular dichroism decreases rapidly, becoming opposite in sign for three of the compounds. It is therefore suggested that the neighbouring absorption band at shorter wave-lengths is also optically active, but that its circular dichroism is opposite in sign to that of the first band. The rotatory dispersion of these compounds has also been measured in the visible and ultra-violet spectrum, including the region covered by the first absorption band. W. F. K. WYNNE-JONES: Acid strength and its dependence upon the nature of the solvent. The dissociation constants of acids in any particular solvent cannot be regarded as a measure of their real relative strengths, since it has been found by Goldschmidt and others that the order of the dissociation constants for a series of acids is dependent upon the solvent. The change in the dissociation constant of an acid on going from one solvent to another is determined partly by the relative basicities of the solvents and partly by the electrical forces between the ions. Since the effect of the former must be the same for all acids, it is proposed to eliminate it by considering not the actual dissociation constants but the constants relative to some standard size. The variations in these relative dissociation constants should then be determined by the electrical forces, and, on the basis of the Born equation, a relationship is deduced.

Physical Society, Jan. 20. SIR ARTHUR EDDINGTON: Notes on the method of least squares. In inferring the value of a physical quantity x from observations, some risk must be accepted. It is therefore presumed that the investigator has made up his mind how much risk he will take, and desires the closest possible limits—the narrowest range of values of x—that he can adopt without exceeding this risk. The aim is to furnish a concise treatment of combination of observations on this basis. Stress is laid on the fact that the method of least squares is justified without the assumption of a Gaussian error law of the observations. Most of the paper deals with quite elementary points, but it ends with a discussion of the more difficult questions which arise in inferring the mean square error of observation from the residuals. MARY BELL and S. E. GREEN: Radiometer action and the pressure of radiation. While the manner in which radiometer action diminishes as the vacuum improves was being investigated, the series of radiometer effects, recorded in the first part of this paper, was observed. Radiation was directed upon light vanes suspended by means of a fine quartz fibre in a flask for a series of vacuum conditions. In the case of a platinised glass vane, at a pressure of a few millimetres of mercury, the deflections on both the glass and the platinised sides were of the order of those registered at the highest vacua obtained. At pressures of about 10^{-2} mm. gas effects developed which were very large in the case of the glass and mica vanes but much less marked with the aluminium vane. With all the vanes, gas action had practically vanished at a pressure of 10^{-6} mm. of mercury. Measurements of radiation pressure were made by the direct method with metal vanes and a vacuum so high that radiometer action was eliminated. The maximum deflections of the suspensions were observed, and the corresponding energy-densities of the radiation were measured by a Callendar cup radio-balance. The results show that the difference between pressure and energy-density varies from + 4 to − 3 per cent. F. J. W. WHIPPLE: The wet-and-dry bulb hygrometer: the relation to theory of the experimental researches of Awbery and Griffiths. Simultaneous values have been published by Awbery and Griffiths of the dew point, of the vapour-content as determined by a gravimetric method, and of the reading of a wet-bulb thermometer, the observations covering a range of air-temperatures from 30° to 100° C. These observations have been rediscussed and it is demonstrated that August's formula by which vapour pressure is deduced from dry and wet bulb readings is valid over the experimental range of temperature. G. I. FINCH and R. W. SUTTON: The control of ignition-coil discharge characteristics. The theory of the ignition coil is developed and is verified by means of the cathode ray oscillograph. It is shown that the spark-gap voltage is constant throughout the life of the inductance component, and that the inductance-component current is oscillatory, but unidirectional. The theory leads to the conclusion, confirmed experimentally, that the closing of the primary circuit during the life of the inductance component rapidly extinguishes the secondary discharge. A contact-breaker, enabling the duration of opening of the primary circuit to be controlled with accuracy over a range between 0 and 2 m. sec., is described. P. VIGOUREUX and S. WATTS: The temperature coefficient of the Weston standard cell. The E.M.F. reached a maximum at about 3°, and at − 20° it was just over a millivolt less than the maximum. The cells behaved satisfactorily at − 16°, but at − 18° freezing took place gradually and was accompanied by a rapid decrease in E.M.F. Frozen cells resumed their normal behaviour when kept at room temperature for about a day. Cooling increased the internal resistance of the cells. An E.M.F. temperature formula valid between − 20° and + 40° is derived.

LEEDS

Philosophical and Literary Society, Dec. 6. E. C. POLLARD : The entry of the disintegrating alpha particle into the nitrogen nucleus and a general relation between heights of nuclear barriers and atomic number. Experiments on nitrogen are described which fix the height of the potential barrier at $4 \cdot 3 \times 10^6$ electron volts. There is an indication of a virtual alpha particle level at 2·2 cm. alpha particle range. The general evidence indicates that the heights of the potential barriers of the light nuclei are proportional to the atomic number. H. M. DAWSON : Ionisation of sulphuric acid. The second stage ionisation of the acid has been determined from reaction velocity data for the hydrolysis of ethyl acetate by the joint catalytic action of the hydrogen and bisulphate ions. The method is probably much more accurate than methods which are based on osmotic (freezing-point, partition) or electrical (conductivity, potential, transport) measurements. The results show that the first-stage ionisation is practically complete and that the second stage ionisation increases from 8·5 to 85 per cent when the concentration of the acid decreases from 0·1 to 0·001 mol. per litre. J. H. PRIESTLEY, LORNA I. SCOTT, and MARJORIE E. MALINS : A new method of studying cambial activity. Details are given of a new 'strip' method of studying the tissues derived from the cambium which seems to be applicable to a wide range of problems connected with radial growth. By the use of this method during 1932, the view that cambial activity recommences in the opening buds and thence spreads basipetally over the old wood of branches and trunk, has been confirmed in the case of some thirty species of hardwoods and six species of softwoods. (See NATURE, 130, 494, Oct. 1, 1932.) GEORGE COCKERHAM : Variations in the total nitrogen content of normal and leaf-roll potatoes. A preliminary study of diurnal variations in the total nitrogen content of the leaves (laminæ and petioles) of normal and leaf-roll potato plants with a note on the distribution of total nitrogen in normal and virus infected tubers.

PARIS

Academy of Sciences, Jan. 23 (*C.R.* 196, 225–304). CHARLES NICOLLE, J. LAIGRET and P. GIROUD : The passage of the virus of exanthematic fevers by the digestive canal in the rat. Experiments were made with three types of virus : the virus was found to be capable of traversing the wall of the alimentary canal of rats. FRANCESCO SEVERI : Some new theorems in algebraic geometry. V. LALAN : The affine signification of the pseudo-arc and of the pseudo-curvature of minimal curves. C. POPOVICI : The necessity of introducing a new idea concerning the discontinuity. GEORGES GIRAUD : Correction to a recent communication. ARNAUD DENJOY : The calculation of the coefficients of trigonometrical series. KING-LAI HIONG : Meromorph functions of infinite order. L. ESCANDE and P. DUPIN : The similitude of transitory regimes in movements of rotation. JACQUES VALENSI : Stream lines in the flow round a cylinder of revolution with a high Reynolds number. ROBERT GIBRAT : The existence of a dangerous rotation velocity, independent of the balancing, for certain turbo-alternator groups. JACQUES WINTER : The phenomena of resonance in undulatory mechanics. COMAS SOLA : The radial velocity of some nebulæ. F. LINK : The photometric theory of eclipses of the moon. D. BARBIER : Remarks on the dynamic parallaxes of double stars. A reply to some criticisms of Finsen. H. BORDIER : The production of Merget's phenomenon by d'arsonvalisation with short waves. Merget's phenomenon, the adsorption of gas when moisture is expelled by heat, has been studied for liquids other than water : data are given for methyl alcohol, acetone and ethyl ether. P. BIQUARD : An optical method for the measurement of the absorption of ultra-sound waves by liquids. If I, I_0, are the light intensities transmitted by the cell when the ultra-sound waves are present and absent respectively, the ratio of these intensities varies linearly with the energy of the ultra-sound waves. YEU-KI-HENG : The action of aluminium salts on alkaline tartrates. CH. BEDEL : The magnetic susceptibility of ferrosilicons rich in silicon. Figures are given for twelve alloys with silicon content varying from 34·64 to 99·86 per cent. All these alloys were paramagnetic. At the composition corresponding to the compound $FeSi_2$ there was a large increase in the magnetic susceptibility. SERVIGNE : The existence of a polonium acetylacetonate. This substance was found to be soluble in warm chloroform, benzene, alcohol and acetone. In chloroform solution the substance was not sensibly ionised. From the study of the isomorphism of known acetylacetonates, the radioelement would appear to be tetravalent. MLLE. SUZANNE VEIL : The periodic precipitation of mercuric iodide. A. PERRET and R. PERROT : Contribution to the study of the cyanide-cyanamide equilibrium. Sodium cyanide was heated with chlorides of lithium, calcium, barium, strontium, magnesium, beryllium, zinc and cadmium, in presence of iron powder as catalyst, and the proportion of cyanamide determined. FRANCIS MEUNIER : The corrosion of welds of mild steel. CHARLES BARON : Carburation in internal combustion motors. P. CARRÉ and D. LIBERMANN. The reaction of thionyl chloride upon phenol. M. BACKÈS : The action of phosphorus oxychloride upon some aldehydes. J. A. MULLER and MLLE. EGLANTINE PEYTRAL : The sudden pyrogenation of ketene. Analysis of the gases obtained by rapidly passing ketene through a platinum tube at 1150° C. The hypothesis that the primary decomposition is into CO and CH_2 is consistent with the results. S. GOLDSZTAUB : The crystalline structure of sodium ferrite. L. ROYER : The orientation of crystals of organic substances depositing in contact with a mineral with ionic structure. G. FRIEDEL : Remarks on the preceding paper. MLLE. HENRIETTE ALIMEN : Important erosion of the Stampian in the Paris basin. MARCEL BADOUIN : An intentional fabrication of an engraving of a horse's hoof on granite, by means of a stone tool. Prehistoric engravings of animal's hoofs on granite rocks have been found in France and elsewhere : the author proves experimentally that such engravings can be readily made on granite with flint tools. EMILE F. TERROINE and MLLE. SIMONE VALLA : The comparative value of various protein foods in growth. The use of a protein food for young animals should not be based on the total nitrogen present, but on the proportion of the protein which can be utilised by the organism for the production of new tissue. Barley is markedly superior to wheat in this respect. P. MEZINCESCO : The utilisation of amino nitrogen by the animal organism. L. BUGNARD, P. GLEY and A. LANGEVIN : The recording and measurement of the blood pressure. The method described, based on the effect of the pressure changes on a piezoelectric quartz crystal, gives a record of the changes in arterial pressure and also the absolute pressure. **Albert Lambrechts**: The spectrographic study of phlorhizine and its derivatives. The ultra-violet absorption spectrum of phlorhizine. **Maurice Piettre**: The flocculation in the organism of colouring matters, chemically defined artificial colloids. **Mlle. H. F. M. Petter**: The structure of *Sarcina gigantea*. **E. Manoussakis**: A method of immunising the rabbit against dysenteric infection.

Forthcoming Events

Monday, March 13

Royal Geographical Society, at 5.—Capt. C. R. P. Diver: "The Physiography of South Haven Peninsula, Studland Heath, Dorset".

Institute of Industrial Administration, at 6.30—(in the Lecture Hall, Institute of Hygiene, 28, Portland Place, W.1).—A. P. M. Fleming: "Research in Relation to Industry".

Tuesday, March 14

Royal Institution, at 5.15.—Sir James Jeans: "Modern Astronomy" (succeeding lectures on March 21, 28 and April 4).

Wednesday, March 15

Royal Meteorological Society, at 7.30—(G. J. Symons Memorial Lecture).—P. M. S. Blackett: "Cosmic Radiation".

Royal Society of Arts, at 8.—Prof. W. A. Bone: "The Chemistry of Hydrocarbon Combustion".

Thursday, March 16

Chemical Society, at 8.—Discussion on "The Chemical Constitution of Oestrin" to be opened by Dr. G. F. Marrian.

Friday, March 17

Physical Society, at 5—(at the Imperial College of Science and Technology).—Annual General Meeting.

Royal Institution, at 9.—Prof. W. L. Bragg: "The Structure of Alloys".

Saturday, March 18

Royal Anthropological Institute, at 2.15—(at St. John's College, Cambridge).—Dr. L. S. B. Leakey: "Discoveries of Human Remains at Kanam and Kanjera (Kenya)".

Royal Institution, at 3.—Developments in Cinematography: A Display of Films, (1) Instructional Films.

Official Publications Received

GREAT BRITAIN AND IRELAND

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 72, No. 434, February. Pp. 93–188+xiv. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

The British Wood Preserving Association. Circular No. 1: The Preservative Treatment of Estate and Farm Timber. By R. C. B. Gardner. Pp. 36+2 plates. (London.) 6*d*.

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended March 31, 1932; with Report of the Director of Fuel Research. Pp. viii+96. (London: H.M. Stationery Office.) 2*s*. net.

Royal Society of Arts. Tenth Annual Competition of Industrial Designs, 1933. Pp. 32. (London.) 4*d*.

Department of Scientific and Industrial Research. Building Science Abstracts, Vol. 5 (New Series), No. 12, December. Abstracts Nos. 2169–2427. Pp. 399–529. (London: H.M. Stationery Office.) 1*s*. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1476 (T. 3208): Stressless Corrosion followed by Fatigue Test to Destruction on Aluminium Crystal. By Dr. H. J. Gough and G. Forrest. Pp. 11+8 plates. 1*s*. net. No. 1483 (T. 3223): Periodic Flow behind an Airscrew. By C. N. H. Lock and D. M. Yeatman. Pp. 15+6 plates. 1*s*. net. No. 1493 (T. 3262, 3294, S. 121): Stability on the Water of a Seaplane in the Planing Condition. By W. G. A. Perring and H. Glauert. Pp. 60+4 plates. 3*s*. net. No. 1494 (T. 3291): Airflow about Aeroplanes shown by Wool-tufts. By B. Melvill Jones and J. A. G. Haslam. Pp. 12+12 plates. 1*s*. 3*d*. net. (London: H.M. Stationery Office.)

Forestry Commission. Bulletin No. 14: Forestry Practice; a Summary of Methods of establishing Forest Nurseries and Plantations with Advice on other Forestry Questions for Owners and Agents. Pp. 108. (London: H.M. Stationery Office.) 2*s*. net.

OTHER COUNTRIES

Canada: Department of Mines: Geological Survey. Economic Geology Series, No. 11: Rare-element Minerals of Canada. By H. V. Ellsworth. (No. 2314.) Pp. v+272. 40 cents. Economic Geology Series, No. 12: Manganese Deposits of Canada. By G. Hanson. (No. 2317.) Pp. v+120. 20 cents. (Ottawa: F. A. Acland.)

Canada: Department of Mines; National Museum of Canada. Bulletin No. 69 (Biological Series No. 18): Methods of Collecting and Preserving Vertebrate Animals. By R. M. Anderson. Pp. v+141. 25 cents. Bulletin No. 70: Annual Report for 1931. Pp. 119. (Ottawa: F. A. Acland.)

University of California Publications in Zoology. Vol. 38, No. 13: Postjuvenal Molt and the Appearance of Sexual Characters of Plumage in *Phainopepla nitens*. By Alden H. Miller. Pp. 425–446+plates 8–9. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 25 cents.

R. Osservatorio Astrofisico di Catania. Annuario 1933. Pp. iv+39. L'Attività del Sole nell'anno 1932. Pp. 14. (Catania.)

Merentutkimuslaitoksen Julkaisu Havsforskningsinstitutets Skrift. No. 80: Vedenorkeusarvoja 1929 ja 1930. By S. E. Stenij. Pp. 84. 35 Fmk. No. 81: Croisière thalassologique et observations en bateaux routiers en 1931. Rédigé par Gunnar Granquist. Pp. 38. 20 Fmk. No. 82: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres Juli 1930—Juni 1931. Herausgegeben von Gunnar Granquist. Pp. 44. 25 Fmk. No. 83: Strom- und Windbeobachtungen an den Feuerschiffen in dem Jahren 1930 und 1931. By E. Palmén. Pp. 85. 35 Fmk. No. 84: Havsforskningsinstitutets värksamhet år 1931. By Rolf Witting. Pp. 15. 10 Fmk. No. 85: Översikt av isarna vintern 1931–32. By Gunnar Granquist. Pp. 50. 35 Fmk. No 86: Untersuchungen über gelöste Phosphate und Stickstoffverbindungen in den nordbaltischen Meeresgebieten. By Kurt Buch. Pp. 30. 20 Fmk. (Helsinki.)

Societas Scientiarum Fennica: Commentationes Physico-Mathematicae. VI, 14: Über die Einwirkung des Windes auf die Neigung der Meeresoberfläche. By E. Palmén. Pp. 50. 15 Fmk. VI, 16: Zur Theorie der Wasserschwingungen in einem begrenzten Meeresbecken, mit besonderer Berücksichtigung des Einflusses von Luftdruck. By S. E. Stenij. Pp. 80. 30 Fmk. VI, 26: Ein selbstschreibender Apparat für Ausmessung von Mareographenkurven. By S. E. Stenij. Pp. 8. 4 Fmk. (Helsingfors: Akademische Buchhandlung.)

Proceedings of the Imperial Academy. Vol. 8, No. 10, December. Pp. xxix–xxxi+475–520. (Tokyo.)

Memoirs of the Indian Meteorological Department. Vol. 25, Part 9: On Evaporation and its Measurement. By Dr. S. K. Banerji and H. M. Wadia. Pp. iii+291–325+3 plates. (Calcutta: Government of India Central Publication Branch.) 2 rupees; 3*s*. 6*d*.

India: Meteorological Department. Scientific Notes, Vol. 5, No. 51: A Preliminary Study of Rainfall at Quetta. By A. K. Roy and R. C. Bhattacharya. Pp. 49–61. (Calcutta: Government of India Central Publication Branch.) 10 annas; 1*s*.

Holiday Courses in Europe, 1933. Compiled by the League of Nations' Institute of Intellectual Co-operation. Pp. 60. (Paris: Institute of Intellectual Co-operation; London: George Allen and Unwin, Ltd.) 2*s*.

Royal Observatory, Hong Kong. Weather Observations from Ships (Appendix to Hong Kong Observations, 1931). By C. W. Jeffries. Pp. 41. (Hong Kong.)

Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 11: Reports of Agricultural Field Officers for the Year 1931. Pp. iv+143. (Kuala Lumpur.) 50 cents.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 5, No. 1, Janvier. Pp. 48. (Prague: Regia Societas Scientiarum Bohemica.)

Państwowa Rada Ochrony Przyrody. Nr. 34: Sprawozdanie z Dzialalności Państwowej Rady Ochrony Przyrody w Roku 1932. By Prof. Dr. Wladyslaw Szafer. Pp. 15. Ochrona Przyrody: Organ Państwowej Rady Ochrony Przyrody. Rocznik 12. Pp. iv+190+4 plates. (Krakow: Państwowa Rada Ochrony Przyrody.)

Mellon Institute of Industrial Research. Bibliographic Series, Bulletin No. 3: A Select, Annotated Bibliography on the Hygienic Aspects of Aluminium and Aluminium Utensils. With a Preface by Edward R. Weidlein and an Introduction to George D. Beal. Pp. xi+80. (Pittsburgh, Pa.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 21, No. 5, December. Pp. 727–935. (Tokyo and Sendai: Maruzen Co., Ltd.)

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Science and Service in Universities Overseas

IT cannot be gainsaid that the inhabitants of England, and of London in particular, are prone to assume an air of superiority over visiting representatives of the Dominions, even when the latter are themselves engaged in the task of building up new universities at the outposts of the British Empire. Necessarily the Empire must have a centre, which can only be London, but acceptance of this postulate does not preclude first-class work on a particular subject being carried out at a university thousands of miles away. It is only required to mention the names of Rutherford and Soddy in connexion with McGill University to establish this point. Whilst it is desirable and indeed excellent to have a cultural centre for the Empire, it would be disastrous if the advantages of proximity to it had the effect of making the foremost teachers, old and young, reluctant to work at the circumference, where there is much educational work of the highest importance to be done.

Among those who take the view—and there can be few who oppose it—that never was the closest union with the Dominions as a whole more essential to the Mother Country and that indeed her future prosperity largely depends on strengthening the bonds which unite the Empire, there is a keen desire to see the best possible use made of the intellectual ability of the Empire to this end. Apart from those few philosophers who can only work under conditions which are to-day's equivalent of monastic seclusion, it would do all the good in the world to most of the younger scientific workers to spend a year or more out in the Empire making contact with life as it is lived under somewhat different conditions from those which prevail at home, conditions which are claimed by some to be nearer the actualities of life.

The basic ideas we desire to develop are, first, the need for the universities of the Dominions to be able to draw on the best brains in the Empire for their professoriate. The material to be taught there is worthy of the teacher; the problems, both pure and applied, to use the hackneyed terms, are there in plenty. Secondly, those who accept such posts should be placed at no disadvantage in their future professional career. As this is at the moment perhaps the crux of the matter, it may be considered in more detail. At the end of the nineteenth century and for a decade in the twentieth it was usual for the enterprising sons of large families to cross the seas to find work under conditions of greater freedom than at home: for all classes the opportunities were greater than at home, and the rising man of science gained a professorship at a substantial salary years before he could have achieved this in Britain. To-day things have changed: the working man no longer emigrates, for a variety of reasons which do not concern us here; the young scientific worker finds sufficient opportunities, including some measure of financial security, to keep him at home and he is unwilling to sacrifice the advantages of scientific centralisation. It must be admitted that part of his reluctance to face life under new conditions in the Dominions is due to his womenfolk, who, however enterprising they may be in sensational sports stunts, are on the whole unwilling to face the different and possibly harder life in the Dominions. It is true the burden of this falls mainly on their shoulders, whereas the daily round of the husband in his laboratory is much the same as at home. The difficulties should be realised in the Dominions, and a specially warm welcome extended to the 'Frau Professor' until she is thoroughly acclimatised to the new conditions.

Although, as Prof. Stanton Hicks emphasises in a letter we are publishing elsewhere in this issue (p. 397), the inducements to attract and retain good men in the Dominions have to be greater than in the past, there is one factor working in the opposite direction which should help, namely, the ever-quickening of transport, which makes it possible to retain much closer contact with England. Eastern Canada is within a week of home, at least in the summer, and both South Africa and Australia are less remote than at one time, and even the cost of the passage is less onerous. Adding the fact that people in the Dominions are used to long journeys, it becomes possible, other things being equal, to visit the homeland much more often than has been customary in the past. Amongst other things we contemplate the payment of a passage to England and back every few years under the conditions of the professorship; this is usual in the case of commercial employees who are sent to the East by their employers. The principle of the sabbatical year is now quite established in the United States, and it should be possible to adopt it, with improvements, within the British Empire. Here the Royal Society might help. It could each year send out one or more of its research professors to the Dominions to take the place of the local professor, who would come home to do a year's research in a British laboratory. We feel convinced that the effects of such exchange on both parties would be remarkable and would in a few years have a profound influence on the whole university movement in the Dominions.

There should be an unwritten law not to overlook workers in the Dominions when awarding scientific honours or making elections to vacant chairs. The Royal Society has always awarded its fellowship with liberality to overseas workers, but it is desirable that the feeling should prevail that the axiom 'out of sight, out of mind' does not apply to them. The difficulty of interviewing candidates overseas for a vacant chair might be overcome by the selection of a carefully chosen panel of seniors, who would meet and record their impressions of them before they first crossed the ocean and during every subsequent visit to the Mother Country. Such a panel would be able to make impartial reports when necessary.

We would go even further in encouraging a knowledge of Empire conditions among professors, by definitely giving preference when filling the senior positions at the universities at home to men who have had such experience. In their turn, the universities in the Dominions must accept the idea of a five years' tenure of their professorships. There will, no doubt, be strong objections to this suggestion because of its disturbing effect on the regular routine of the university, but in the long run there can only be benefit from the new ideas brought in by the new man and the new stimulus he will give to staff and students alike. It is in no way suggested that the term of office should be limited to five years, only that it should form a period after which a teacher would be considered to have discharged his obligations should he wish to return to England.

It is an open question, not suitable for debate here, whether some chairs should not be definitely limited to a five years' period; others again, after a period of probation, might well be for the period of active life. In those sciences which are in close connexion with the active industrial development of a Dominion, we believe there is much to be gained by a regular change in the occupant of a chair: we can even visualise the new man coming out of industry, the retiring professor entering or returning to industry, to the advantage of individuals, students, industry and the university. There must be a real contact between the university and the town and State in which it is situated; it must play a part in the agriculture, in the industries, in the development and in the life of the community and be far, far more than a high school to which the citizens send their sons and daughters. 'Town and gown' must not be different and opposing unities; the gown must be thrown round the town and the townspeople made proud to wear it.

We have stressed this, the practical function of a university overseas, without any intention of minimising or detracting from the other functions it should have, that of teaching and that of pure research. The best kind of teaching is so much a matter of inspiration—a few words from the right man can make a dull subject an entrancing mystery—that this is largely a question of the individual teacher. Unfortunately, universities must grant degrees, and degrees involve examinations, which in their turn mean a syllabus and courses of instruction, none of which is really education for life's battles in the true sense of the word. There is no hope of changing this state of affairs at the moment at home, though overseas the authorities may perhaps be more enlightened since they are more closely in touch with the realities of life. So long as there are examinations, teaching in the main must be directed to covering the facts contained in a comprehensive syllabus and not to the presentation of a logical approach to the subject itself. Apparently the good students survive even the examination and its preparation, and the inferior might never learn the subject anyway, so the old bad ways are perpetuated.

There are several aspects of the research question at the overseas universities. A good man will prosecute the research in which he is interested anywhere, whatever the conditions. Sir Daniel Hall has reminded us that research proceeds from an artistic impulse, so that it is not under control. The best results in the past have not come out of the institutions with the finest equipment, witness Sir William Ramsay's laboratory in London and that of Emil Fischer in the Dorotheen Strasse, Berlin, both the scene of epoch-making discoveries. More difficult to overcome is the lack of stimulus resulting from the regular contact with other workers. However, the typewriter makes it possible to write lengthy letters with a minimum of effort, which, with the good postal facilities available, should enable the written to replace verbal intercourse. The work achieved in the laboratories of the British Empire—there is no need to mention names—makes it abundantly clear that the right type of man can produce the best work in them and that he need not fear intellectual starvation. It should perhaps also be said that in many of the Dominion laboratories the equipment is of the best, even in advance of much of what we have at home. It is true that modern physics demands a super equipment, such as has just been installed at Cambridge, but there are many other fields of scientific endeavour where the apparatus and materials necessary for a research can be packed up in a few cases and moved from one laboratory to another. The prolific researches of the professors of chemistry at Oxford, for example, give no indication of having suffered as the result of their having worked in several laboratories in the Old World and the New.

The developments in the United States afford an illustration of how universities in cities in remote States, possessing a very inferior cultural background, have developed here and there under the leadership of individuals of the right type into first-class schools of research and teaching. It is true the distances from Yale or Harvard to these centres are small, but a decade or so back it was very difficult to persuade the best men to take up these positions in the Middle West.

We have still to consider our theme in relation to graduates of the Dominion universities who come, as indeed they should, to the Mother Country for post-graduate work. Should they stop in England or return to take up posts in the countries whence they came? The temptation must vary with the individual. Some will feel family ties and associations and the pull of the freer life and better climate, others will feel the beckoning finger of the academic atmosphere. Each must choose for himself in relation to his inclinations, but one thing is certain, that we at home, spectators in the auditorium, must applaud him who goes abroad as loudly as the man who stays at home. The success of the Empire depends rather on the deeds of the man on the spot than on speeches at Westminster, and no insular narrow-mindedness must be allowed to stand in the way of giving him the best men as his teachers.

It is perhaps trite to say the world is at the cross-roads. There are many who think that for Britain, one way points towards sterling and the Empire and the other towards gold and uncertainty, if not chaos. If we choose the former and build on the foundations laid at Ottawa, unite with people of our own blood and our own tongue into a closer union, leading, let us pray, to Imperial greatness, then it must be remembered that we are all free men of independent habit of mind, so that Imperial unity means Imperial independence, a centrifugal force opposed to centralising everything intellectual in the capital of the Empire.

In the world as it is to-day, no unit is big enough to stand alone. Economic groupings are necessary, the most beneficial being that of a big industrial nation with a big agricultural nation. Just as some forms of agriculture are so uneconomic that their practice results in raising the cost of living, so also the costs of manufacture must be kept low if Britain is to be the great central industrial country. Success in attaining these ends lies in the advances that science can make, such as will enable, for example, the big agricultural business to compete with the one-man farm, the rationalised industry to meet the competition of the small business. As regards the Dominions, it is clear that when a country has great resources of raw material, it will certainly attempt to establish its own industries, but it should only afford them a protection by tariff when they are reasonably assured of sound opportunities for success.

If the industries of the Dominions, agricultural and otherwise, are to prosper, research at the universities must be fostered, for in agriculture there are no great corporations to endow research. Sheltered places must be provided for the research workers and the shelter must be of a nature that will attract the best. Only thus shall be established our claim to Imperial greatness.

Evolution and Philosophy

The Scientific Basis of Evolution. By Prof. T. H. Morgan. Pp. 286. (London: Faber and Faber, Ltd., 1932.) 15*s*. net.

THE present book, based on a course of lectures at Cornell University, represents the views of a leading geneticist concerning the present position as regards evolution. It contains little that is new to the geneticist, and its statements are apparently designed mainly for the more general reader. The earlier chapters are concerned with such topics as the cellular basis of heredity, Mendelian inheritance and the genes, variability, adaptation and natural selection, mutation, sexual selection, and the evolutionary significance of embryonic development. The last four chapters are essentially a critique of (1) the well-worn theme of inheritance of acquired characters; (2) the social evolution of man; (3) the conception of the 'order of Nature', and (4) of metaphysical interpretations of evolution.

Although the work deals mainly with the more recent developments, occasional pages might have been taken from almost any textbook in the last fifteen years. There are a few inaccuracies, especially as regards plant genetics. For example, it is stated that *two* cases are found where interspecific crossing has produced new stable types with a higher chromosome number. The list of such cases in plants now extends to at least eighteen, and the most significant ones from an evolutionary point of view are not mentioned. Similarly, the statement (p. 44), "Whether this growth [of the chromosomes] takes place at the time of splitting, or after the halves have moved apart, is not certainly known at present", can only be regarded as a very inadequate statement concerning present knowledge of the growth and division of chromosomes.

In the chapter on mutations, the frequency of viable mutants in *Drosophila* is estimated at one in five to ten thousand flies. The discussion of the relation between the mutation theory and natural selection reaches the conclusion that some of the mutants will be an improvement, either on the old characters, or in a somewhat different environment and will therefore be incorporated into the species. It requires more than this, however, to show that mutations furnish the material for evolution. It would seem reasonable to expect that evidence on this head could be obtained in part by a comparison of the mutations in any group of organisms with the interspecific differences found in that group. Hitherto very little work of this kind, involving both mutational and taxonomic studies, has been done.

Elsewhere (p. 182) Morgan concludes that there may have been as many genes in the earliest organisms as at present. Such a view, if pressed to its conclusion, can only mean that the genic differentiation of the chromosomes of an amœba is as great as in man, a conclusion which would certainly not be accepted by many biologists. It would seem that the gene theory can only be reasonably maintained on the assumption that the chromosomes of higher organisms are more differentiated along their length than those of the lower forms. The opposite view savours more of Bonnet's *emboîtement* theory than of evolution in a real sense.

On p. 205 the extraordinary statement appears, that "Only a few strictly dominant mutational changes are known in man", brachydactyly being cited as an example. In the literature of the subject, dominant abnormalities are very frequent, and probably even more so than recessives. The latter, however, owing to their nature, may of course be more numerous in the human germ-plasm.

In his first and last chapters especially, Morgan wields a stick against the "metaphysicians and philosophers of sorts". Whitehead, Jeans, Eddington, J. S. Haldane, Smuts and others in turn come in for castigation. The author's attitude may be gathered from the statement (p. 239), "By patience and industry and intelligence, biologists hope to advance their work. But so long as they have not found convincing evidence, it is an 'open season' for philosophers, who are too impatient to wait, but must add the biological field to their speculations." Although "philosophers" are thus warned off the field of biology, yet the author appears to recognise that the philosopher may have his function in the scheme of things when he says that "the scientist cannot afford to be entirely contemptuous of the history of philosophic and metaphysical thought, or to assume an arrogant disregard for it". But he accuses metaphysicians of placing limitations on exploration by scientific methods, and of assuming that the methods of science can have no bearing on the topics "reserved by metaphysicians". Behind the mechanistic position which Morgan defends there appears to be the assumption that when a man ceases to be a mechanist in the generally accepted sense, he *ipso facto* loses his scientific status.

This book will doubtless claim the interest of a wide range of readers. R. RUGGLES GATES.

Destructiveness of Earthquakes

Earthquake Damage and Earthquake Insurance: Studies of a Rational Basis for Earthquake Insurance; also Studies of Engineering Data for Earthquake-Resisting Construction. By J. R. Freeman. Pp. xiii + 904. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 7 dollars.

DR. FREEMAN, whose death has recently been recorded in our columns, broke new ground in this large volume, for no other work has yet been published that is devoted exclusively to the damage caused by earthquakes, the methods by which it may be lessened, and the covering of loss by insurance. Naturally, he deals for the most part with the earthquakes of the United States, though chapters are also given to recent shocks in Italy, New Zealand and Japan. But, for workers in all countries, the data here collected with the admirable series of illustrations will be found most useful. The chief regret that one feels in closing the volume is that the author lacked the time for its careful revision. The whole book might easily and with great advantage have been condensed to perhaps half its present length.

As Dr. Freeman points out, there is no region in the United States or Canada that can be regarded as wholly immune from the possibilities of earthquake damage, though the risk is far less on the east, than on the west, side of the Rocky Mountains. Two of the greatest earthquakes in the country—the New Madrid earthquake of 1811 and the Charleston earthquake of 1886—occurred, however, in districts that had been almost, though not quite, free from disturbance since the discovery of America. A very important feature of nearly all American earthquakes is that serious damage is confined within a comparatively small area. The Charleston earthquake, for example, though it was felt to a distance of 800 miles from the centre, was destructive to property only within three areas, each containing less than one square mile. Indeed, Dr. Freeman states that the area of severe destruction in American earthquakes has never exceeded 10 square miles, except in the New Madrid earthquake of 1811, the Owens Valley earthquake of 1872 and the Californian earthquake of 1906, and in the last-named was not more than 400 square miles.

Moreover, even within the central area, the ratio of damaged to undamaged houses is usually small. The buildings that are badly injured in an earthquake, whether of American or other origin, have nearly always been of weak and inferior construction. Well-built structures of wood or brick, or of squared stone laid in strong mortar, have usually withstood an earthquake shock. Even in the destructive earthquakes in Japan in 1923, Santa Barbara in 1925, and Nicaragua and New Zealand in 1931, buildings of monolithic reinforced concrete, deposited round well-designed steel skeletons, have as a rule survived unharmed. Earthquake-proof buildings may thus be erected up to 100 ft. in height, within reasonable limits of cost, whatever the ground on which they stand; and Dr. Freeman therefore considers that it would be possible to combine earthquake insurance with fire insurance in the same policy at an increase in cost that would be small for the whole region east of the Rocky Mountains, and in California at an amount far less than that at present charged.

No one can deny that many good buildings have been seriously injured by earthquakes, but in estimating insurance hazards we have to deal with averages. The photographs of ruin that are included in published accounts are designed to thrill the reader. There would be no interest in depicting the buildings that have sustained little or no injury. In Charleston in 1886, for example, the ratio, as Dr. Freeman calls it, of earthquake damage to sound value scarcely exceeded 10 per cent. Out of 6,956 buildings examined, only 102 were ordered to be pulled down. In the remaining houses, the damage consisted for the most part merely of broken chimneys or cracks in walls or plaster. In the published accounts the emphasis was laid on the wreckage; little was said about the buildings, of which the author gives nearly fifty photographs, that passed through the trial unharmed.

The strongest earthquakes in North America within the historical period are those of Quebec in 1663, New Madrid in 1811, Owens Valley in 1872, Charleston in 1886, San Francisco in 1906 and Santa Barbara in 1925. It is improbable that an earthquake more violent than any of these will visit the country. Thus, the author suggests that an area of 2,500 square miles may be considered as the limit of serious destruction, and that within this area an average loss ratio of 5 per cent would be an excessively generous allowance. Taking into account the known frequency of destructive earthquakes in the various regions of the United States, he concludes that (rendered in English money) the following rates per £100 value of the property would cover the probable loss of damage from earthquakes, apart from working expenses and profits: California within fifty or sixty miles from the coast and including the Imperial Valley, 2*s.*—after the Santa Barbara earthquake of 1925, the rates actually charged were 5*s.*–8*s.* per £100, according to the type of building—Californian Mountains east of the Great Valley, 1*s.* 5*d.*; Washington and Oregon within a hundred miles from the coast, 1*s.* 2*d.*; Rocky Mountain-Wasatch region, 7*d.*; Great Lakes and Mississippi region below the Missouri confluence and within ten miles of the bottom lands, 5*d.*; the Atlantic region within fifty miles from the coast, 2½*d.*; and more than fifty miles, 1¼*d.*

Electrolytes

Elektrolyte. Von Prof. Dr. Hans Falkenhagen. Pp. xvi + 346. (Leipzig: S. Hirzel, 1932.) 23 gold marks.

THE author of this volume, now professor at the University of Cologne, studied at Zurich under Debye, and then in the United States at Madison, where he came into close contact with American workers on aqueous solutions. His book on electrolytes is only about one-third of the length of Walden's well-known monograph, but is a much more formidable work, since it includes 759 numbered equations, and demands a standard of mathematical knowledge which may perhaps be common amongst physicists, but is certainly rare amongst chemists.

The historical electrochemistry of Faraday is summarised in a single paragraph, and the whole output of the Ostwald school is condensed into a few pages, in which data which were formerly quoted as evidence in support of Arrhenius's 'classical' theory of electrolytic dissociation are now cited as proof of the inadequacy of that theory. The subjects which the author excludes from his principal text are, however, referred to in footnotes, where abundant references are given to the relevant literature, for example, on acids and bases, homogeneous catalysis, pseudo-electrolytes, etc.

After thus clearing the ground in three short chapters, occupying only 38 pages, the author provides two chapters on activity and on the anomalies of strong electrolytes, followed by five chapters dealing with the explanation of these anomalies by the Milner-Debye theory, as applied to the thermodynamics, conductivity and viscosity of aqueous electrolytes. A chapter on concentrated solutions is of interest as evidence of a reaction from the first hasty impression that all strong electrolytes are completely ionised under all conditions. In this chapter methods are discussed for calculating the true degree of dissociation, not only of formic and iodic acids, but also of salts such as potassium iodide, which crystallise in typical ionic aggregates. A final short chapter deals with the statistical basis of Debye's theory as developed by R. H. Fowler and by Kramers.

The book as a whole can scarcely be regarded as suitable for 'arm-chair' reading, but is perhaps not unduly difficult in view of the character of

post-War work on electrolytes. It will therefore be useful to readers who are anxious to bring their knowledge of the subject up to date; and those who are repelled by the mathematical equations may be attracted by the curves which are used to show the deviations of even the best-behaved electrolytes from the ideal laws laid down for them. An introduction by Prof. Debye sets a seal of authority on this exposition of the Milner-Debye theory of electrostriction.

Short Reviews

Plane Algebraic Curves. By Prof. Harold Hilton. Second edition. Pp. xv + 390. (London: Oxford University Press, 1932.) 28*s.* net.

IN this new edition of Prof. Hilton's able work on the theory of plane algebraic curves, which was first published in 1920, advantage has been taken to recast several important chapters without disturbing the original pagination. Those who are acquainted with the first edition will agree that the author has considerably clarified the text in these chapters and has added fresh proofs to several important theorems, notably on pp. 76, 101 and 199. This should certainly stimulate a greater interest in an admittedly abstract branch of analysis. A considerable portion of the matter is the result of the author's own investigations into the subject. Especially is this the case in the chapters on quadratic transformations, derived curves, unicursal quartics and quartics of deficiency one and two.

No systematic references to original papers are given except at the end of chap. xx on circuits. As a reason for this the author points out: "in a field which has attracted so many workers, it would be almost impossible to trace the steps by which particular results have reached their present form". Whilst this is quite true, it seems a pity that a few of the more important papers were not mentioned in other chapters so that the reader wishing to pursue his studies further might know where to turn.

Every chapter contains an excellent set of exercises, well graded and of reasonable difficulty. Many of the problems are also supplied with hints for their solution. Valuable guidance in reading is provided in the preface, where also will be found a list of errata, as small typographical errors have not been corrected in all cases.

Statistical Methods for Research Workers. By Dr. R. A. Fisher. Fourth edition, revised and enlarged. Pp. xiv + 307. (Edinburgh and London: Oliver and Boyd, 1932.) 15*s.* net.

THE volume under review is the fourth edition, revised and enlarged, of a "Biological Monograph" first published in 1925. As the editors point out, "Conspicuous progress is now being seen in the field of general physiology, of experimental biology and in the application of biological principles to economic problems". This involves the analysis of large masses of data by statistical methods, in the process of which, solutions to many complex problems have to be sought. Stimulus is thus given to purely mathematical researches, upon which the methods dealt with in the book are based. The aim of the author is to apply accurate tests to practical data by systematically attacking small sample problems on their merits. No attempt is therefore made to prove rigorously the various propositions upon which the theory rests; for these the reader is referred to an excellent bibliography at the end.

In this new edition, greater emphasis is laid on the principle of covariance on account of its increasing use in analysis, and a new chapter dealing with the principles of statistical estimation has been added. There are also provided numerical tables of normal distributions, correlation coefficients, etc., in a form suitable for mounting on the faces of triangular or square prisms.

The monograph is indeed a very valuable contribution to the subject by an acknowledged expert, and should prove exceedingly useful to research workers in the field under survey.

Plasticity: a Mechanics of the Plastic State of Matter. By Dr. A. Nádai, assisted by A. M. Wahl. (Engineering Societies Monographs.) Revised and enlarged from the first German edition. Pp. xxiii + 349. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 30*s.* net.

IT is not often that one can say, *ex animo*, that a book "fulfils a long-felt want". This is, however, very true of Prof. Nádai's volume, which brings together in a scholarly fashion much scattered information, otherwise difficult of access. The book is divided into two parts. Part I deals with the plastic state of matter with special reference to metals and to mechanical engineering problems, while Part II is concerned with applications of the mechanics of the plastic state to problems of geology and geophysics. The treatment is singularly clear and full throughout, and is built up on a sure theoretical basis in a manner which makes very pleasant reading.

The book is the first of a series of Engineering Societies Monographs published under the auspices of the American Society of Mechanical Engineers. It has been enlarged from the first German edition with the co-operation of the author, and the Publications Committee of the A.S.M.E. is to be congratulated on having made the work accessible to those unacquainted with the German language.

Not only the practising engineer, but also the physicist and geophysicist, will find the volume a very valuable store of information. A. F.

Die Feldspäte und ihre praktische Bestimmung. Von Dr. Karl Chudoba. Pp. x + 54 + 4 Tafeln. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1932.) 5 gold marks.

THIS book is intended primarily for the use of the working geologist and petrographer who require accurate but rapid methods of felspar determination applicable to thin sections.

The author has made a wise selection and only those methods are described which give simple and rapid determinations. Twelve pages are devoted to a short description of the general chemical, morphological and optical characters of the felspar group, the remainder of the work being concerned with determinative methods. The main interest naturally attaches to the determination of the plagioclase series, and each method is considered under the headings, "Principal of the Method", "Recognition of the Section", "Determinative Process", "Application of the Method" and "Control of the Determination".

Only the methods suitable for use with the ordinary polarising microscope are considered. Adaptations of these to the Fedorow stage (zonal method of Rittmann) are clearly described but the ordinary Fedorow methods are not treated as they cannot be recommended where speed is an essential. The book is well printed and the figures simple and clear. The text is free from all unnecessary theoretical complications and the book provides an admirable guide to all concerned with felspar determinations.

Almost Periodic Functions. By A. S. Besicovitch. Pp. xiii + 180. (Cambridge: At the University Press, 1932.) 12*s.* 6*d.* net.

THE present book by one of the earliest workers in the subject treated in it promises to become a standard work. In some 190 pages it gives an account of the fundamental theorems dealing with almost periodic functions apart from some special problems connected with differential and difference equations. The first chapter develops the theory of uniform almost periodic functions of a real variable, including the representation by generalised Fourier series and their summation. The second chapter gives various generalisations of almost periodic functions with applications of the Parseval equation and the Riesc-Fischer theorem, topics with which the author is especially familiar through his own researches. The third and last chapter gives an account of H. Bohr's theory of analytic almost periodic functions of a complex variable, their Dirichlet series and their behaviour in and on the boundary of a strip of uniform almost periodicity.

The book, from the abstract nature of its subject matter, makes difficult reading, but will prove most interesting to all those sufficiently well equipped with a knowledge of the theory of functions. It is well arranged and printed in the excellent style associated with the publications of the Cambridge University Press.

The Nidification of Birds of the Indian Empire. By E. C. Stuart Baker. Vol. 1: *Corvidæ—Cinclidæ.* Pp. xxiii + 470 + 8 plates. (London: Taylor and Francis, 1932.) 30*s.*

THE author, fresh from his triumphs of the "Fauna of British India" in eight volumes, has turned his specialist's knowledge to the nidification of the birds, mentioned in his former work. To show how busy the field naturalists have been we mention that the percentage of known eggs has risen from 48 per cent in Oates's work in 1889 to 82 per cent at the present time. The number given to the birds in this volume is the same as the number used in the "Fauna", so that the worker has no trouble in turning up any bird.

In the introduction is given a history of the century of work that has been done on Indian ornithology, with oology not considered until 1864. In 1869 the study of oology may be said to have been begun in a serious way by Hume. It is forty years ago since any book has been published solely on the nidification of Indian birds, so in this volume we again expect the last word on the subject. The author's own collection of eggs, numbering more than 200,000, places him in an authoritative position.

Baker reviews the oology of each species as systematically as possible. Complete breeding area is given, with a description of the place where nesting took place, and the season when eggs are to be found; then a description of the nest and eggs, all full and useful to the worker.

Dielectric Phenomena. 3: Breakdown of Solid Dielectrics. By S. Whitehead. Edited, with a Preface, by E. B. Wedmore. (Published for the British Electrical and Allied Industries Research Association, being Reference L/T. 42.) Pp. 346. (London: Ernest Benn, Ltd., 1932.) 30*s.* net.

THE present volume completes a survey of discharge phenomena in dielectrics. The previous volumes discussed the phenomena which occur in gases and liquids. The experimental evidence is presented first and is followed by a study of the theoretical work that has been published. The author says that when an electric stress is applied to solid insulation, only a small heating current passes initially. As the applied stress increases, the current also increases. At a certain critical value the current becomes unstable. The material can now no longer be regarded as a non-conductor. This sudden fall of resistance is usually taken as the criterion of breakdown. The most noticeable feature in a breakdown is usually the perforation caused in the dielectric, the material being decomposed, fused or volatilised, or the whole three effects may occur together. None of the theories given is very convincing but the author gives a clear presentation of all of them. The work will be helpful to research workers on this subject who are doubtless on the look-out for a theory that fits the experimental data. At the present time the problem appears to be a very difficult one.

The Musk-Rat in Britain

By PROF. JAMES RITCHIE

IN recent months a great deal has been written about the musk-rat in Britain, but too much attention cannot be focused upon its presence and the possibilities of its presence. Besides, a special scientific interest is attached to its story, apart from the economic problems to which it has given rise, for we are watching to-day, from its beginning, the development of an example of the untoward spread and destructiveness of an animal introduced into a new environment, which will take its place with the notorious examples of the brown rat in Europe and the rabbit in Australia.

The interest in the breeding of wild animals for their fur which had been aroused in Europe by the value of the pelts and the success of American experiments, was intensified in Great Britain after the War, since fur-farming, as a new, interesting, and presumably profitable occupation, seemed to offer a way out of the difficulties of unemployment or uncongenial employment. It began with the development of highly specialised breeds of rabbits, led to the introduction of silver foxes for the breeding of which there were already in Great Britain in 1929 thirty-two farms with a stock of eight hundred foxes, and at length brought the musk-rat or musquash (*Odonatra zibethica*). The danger of the arrival of the musk-rat ought to have been foreseen and provided against, for its introduction to the upper valley of the Elbe in Bohemia in 1905 had in twenty years caused serious trouble and entailed much expense throughout great stretches of the valleys of the Elbe and the Danube and their tributaries.

Nevertheless, in 1927, musk-rats were imported for breeding purposes to England and Scotland, and although the value of the imported stock as a rule ensured that in these and later importations care was taken to enclose the animals, in one case at least the musk-rats were turned down on the banks of a stream in order to colonise the area. But whether enclosed or not, musk-rats possess a *wanderlust*, and their habit of burrowing makes them difficult animals to confine by any simple system of enclosure, a fact which was not sufficiently realised in the early days. So that each established colony, except where it was enclosed in escape-proof pens, became a potential centre of distribution. It is said that in the spring of 1931, before the Government had taken any steps in the matter, nearly two hundred people in Britain were keeping musk-rats.

Now it must be admitted, in partial justification of the delayed action of the Government departments concerned, that there was no *certainty* that the musk-rat would thrive under wild conditions in Britain. Central Europe held its warning, but in most of their native haunts in North America musk-rats have shown no undue tendency to increase or spread, nor have the stocks introduced to Finland done so. In the former region, natural control is exercised by carnivorous animals, the mink subsisting very largely upon musk-rats during the winter, while a less share in their destruction is taken by coyotes and lynxes; in the latter region, perhaps unfavourable climate and topography take the place of biological control. In Britain it almost required an experiment to test the possibilities, and such experiments were carried out in the enclosed marshes in which some breeders had liberated their stock. Unfortunately, undesigned experiments came thick and fast owing to escapes, and it was soon apparent that in the absence of biological control, climate and other factors in environment favoured undue multiplication.

Too late in the day to gain an immediately effective hold over the musk-rats in Britain, Parliament passed the "Destructive Imported Animals Act" of 1932, which, with subsequent Orders made by the Minister of Agriculture and Fisheries and the Secretary of State for Scotland, imposed restrictions upon the importation and the keeping of these animals. Since the "Musk-Rats (Importation and Keeping) Order" of March 31, 1932, no licence has been granted for importation, and fourteen licences have been granted for keeping (two of which have become void), under which the animals must be kept in specially constructed pens and must not be kept in the open. On the premises so licensed there are at present about 226 musk-rats. On March 14, a further Order was issued prohibiting absolutely as from April 1, unless Parliament resolves to the contrary, the importation into, and keeping within, Great Britain of musk-rats.

Before the passing of the Act, musk-rats had established themselves in several areas where they have increased and whence they have spread over considerable tracts of country. So that in England wild individuals have been found in Yorkshire, it is said in three of the home counties (Surrey, Kent and Essex) as well as in the Fen district, but the great centre of dispersal has been the Shrawardine Pool, in Shropshire, where on a marshy area of sixty-five acres, two hundred individuals were turned down in an enclosure in 1929, bred freely and, inevitably, contributed a quota of 'escapes'. Radiating from that centre, about seventy miles of the Severn and its tributaries, from Pool Quay to Leighton, have been colonised, and the developments in Montgomeryshire and Shropshire and their immediate surroundings threaten any counties connected therewith by waterways. So far, however, the Ministry of Agriculture and Fisheries has not yet been able to verify any serious case of infestation outside the Severn area, although with so rapidly breeding a creature any local colony may flare up as a new centre of increase and distribution.

In Scotland musk-rats were known to be free in Kincardineshire, the northern limit, although a locality in southern Aberdeenshire has been suspected, and they are said to have been seen at Thornhill, Dumfriesshire, the southern limit, but the main region of infestation lies in the Midlands, in Perthshire and Stirlingshire, where they may be present in any district which is connected by waterways with the River Allan. In the enclosure at Whitemoss Loch, Dunning, there are about a thousand musk-rats. Since the passing of the Act, more than sixteen hundred individuals have been killed in England, and about a hundred in Scotland.

A difficulty in discovering the exact whereabouts of the musk-rats is that of identification on sight, yet it is of the highest importance that their presence or suspected presence should be reported at once to the local authority and the Government department of agriculture. Two British animals are occasionally confused with the musk-rat, the common brown rat and the water-rat or water-vole. Accordingly a photograph of these three species is reproduced (Fig. 1), from specimens in the Royal Scottish Museum, as the simplest means of showing their differences. The first obvious character is size: the musk-rat is larger than either, 22 inches from snout to tip of tail when full-grown, although exceptionally large brown rats have measured 19 and 20 inches. A second characteristic is the long, dense, rich brown fur, the musquash of furriers, composed of a close under-coat and longer glistening guard-hairs, giving the creature a more robust and 'dumpy' appearance than the sleek brown-rat or water-vole. A final safe distinguishing mark is the tail, which, instead of being round, is flat, compressed sideways, and since it is hairless looks and feels like a narrow black razor-strop. A close inspection would show that the hind feet are large and partly webbed.

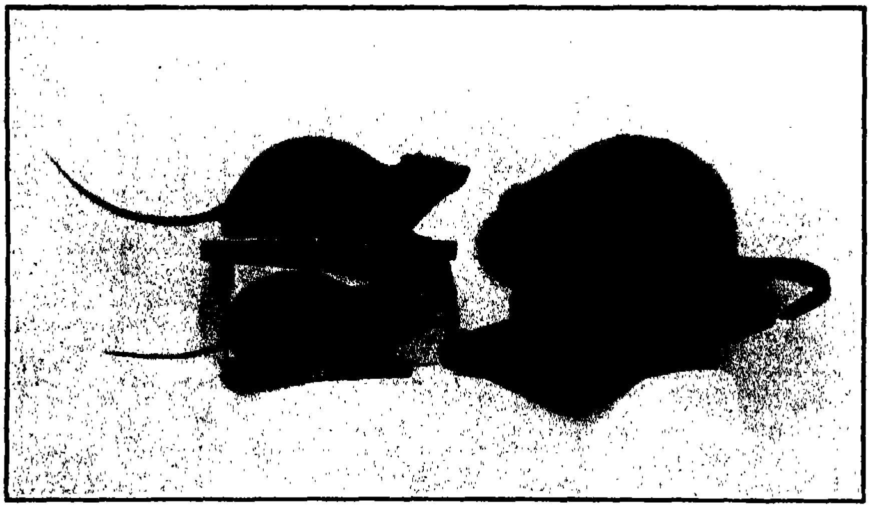
FIG. 1. Right, musk-rat; top left, common brown rat; bottom left, water-vole.

Unfortunately, it is rarely that musk-rats show themselves during the daytime even when they are in numbers, so that other signs of their presence must be looked for. Two of these are illustrated, from Scottish localities; a deep shelter channel cut to give screened access between waterway and feeding ground (Fig. 2), and, most characteristic at this time of the year, the mounds of rushes, grass, leaves and twigs (Fig. 3), which stand three or four feet above the level of the marsh, and are the 'lodges' or joint food-stores and dwelling-houses in which many individuals congregate during the winter months.

The remaining activities of the musk-rat are for the most part invisible, but nevertheless in them lies the great danger of its presence. It lives mainly upon aquatic vegetation, although on the Continent it has damaged green and root crops, and it also eats animal food such as fishes and molluscs; but the loss from these sources is not likely to be very serious. On the other hand, in a country such as Great Britain, with extensive valleys and waterways kept from flooding by natural or artificial embankments, its burrows are a permanent and serious source of danger. The musk-rat is never found at any great distance from water, and in the banks of the streams it frequents it drives multitudes of burrows, since each nest-cavity has its own connexions. The burrows open beneath the water level and the excavated earth is deposited in the bed of the stream, so that unlike the mole's tunnelling, that of the musk-rat leaves no apparent traces. An embankment apparently sound may be honeycombed with cavities, ready to give way on any undue pressure, with what consequences in some localities one can imagine. Here lies another sign of occupation not to be disregarded. Every broken bank in any situation near water should be examined to see if the collapse was due to burrowing, and a distinct musky odour in such place, due to a secretion of the perineal glands of the occupants, should be an aid to identification.

Invisible occupation and spread, extensive undermining of embankments, and a gift of rapid multiplication, for there may be from three to five litters in a year each with six to eight young on an average, combine to make the musk-rat a very dangerous invader.

The danger is realised by many, but it cannot be too widely known. An official of the Canadian Pacific Railway Co. has stated that, in America, apart from damage to canal systems, the creatures "have been responsible for the subsidence of enormous concrete structures, such as head-gates, dams and pool walls, whilst similar timber structures have been completely washed out following the operations of a rat colony in their vicinity" (*Field*, Dec. 17, p. 931, 1932).

What can be done to meet the need of the case? In America musk-rats are easily caught by trapping, and the letter in the *Field* referred to above and another (Dec. 24, p. 966) give excellent summaries of the methods of using traps. But the position in America is a little different; there the musk-rat does no harm in many areas and is an annual source of income, so that the trapper has no wish seriously to deplete the breeding stock. In Great Britain the only aim must be extermination. The departments of agriculture are doing their best, by propaganda against the pest, by the employment of trappers, and by the engagement of Continental experts familiar with the methods employed in Central Europe. These are reported to be confident that "given the men, the means and the time, a properly organised campaign can clear the country". But the condition of Central Europe, with its 100,000,000 musk-rats steadily increasing in numbers and range in spite of every effort, casts some doubt upon the prophecy.

Trapping is necessary but it is not enough, and unconsidered measures run a risk of doing more harm than good. Recently the Ministry of Agriculture and Fisheries advised the destruction of vegetable growths in the Thames, on the ground that the removal of a favourite food would prevent the settling down of the musk-rats and lead to the use of the streams only as highways. But a present need is to restrict the distribution of the animals and to discourage the use of highways to new areas, and, apart from that, the destruction of water weeds is likely to affect seriously the invertebrate fauna and the shelter of the river and, through these, the valuable fish fauna.

Photo *T. Munro*

FIG. 2. Screened access between waterway and feeding ground.

Photo *T. Munro*

FIG. 3. 'Lodge' or joint food-store and dwelling-house.

The Scottish Department of Agriculture, in addition to the employment of trappers, offers a reward of 5*s*. for the killing of musk-rats in certain areas, possibly a useful means of obtaining early information regarding new distribution, and it has tested a mode of destruction which seems to have much in its favour. Trapping is a device against individuals, but in winter the lodges are inhabited by congregations of individuals, which offer a target in the life-history against which every effort of control should be concentrated. The bombing of lodges by miniature bombs, or even the dynamiting of large enclosed areas frequented by many musk-rats, so that they should either be killed outright or disabled by the concussion, ought to be fruitful in results. Any and every reasonable means must now be taken to exterminate this destructive alien, while it is still restricted to a few limited areas. Central Europe points not only to the danger of overwhelming multiplication, but also to the need of devising new and more drastic methods of attack against the pest.

Recent Researches on the Transmutation of the Elements*

By THE RIGHT HON. LORD RUTHERFORD, O.M., F.R.S.

IT is now well established that the change of one atom into another can only be effected by the addition or subtraction of one of the constituent particles of the atomic nucleus, for example, an electron, proton, neutron or α-particle. Such a transformation was first accomplished in 1919 for the element nitrogen by bombarding it with swift α-particles from radioactive substances. About one α-particle in 100,000 comes so close to the nucleus that it enters and is captured by it. This violent disturbance results in the expulsion of a proton with high speed, and the formation of a new nucleus of mass 17. A number of light elements can be transformed by α-particle bombardment in a similar way, and in most cases a proton is ejected.

A new and strange type of transformation was discovered last year by Chadwick: when α-particles bombard the metal beryllium, uncharged particles of mass 1 called neutrons are expelled. These neutrons, which have remarkable powers of penetrating matter, are themselves very efficient agents for the transformation of atoms. Feather has shown that both nitrogen and oxygen are transformed by the capture of neutrons, with the expulsion of a fast α-particle. The types of transformations produced by the neutron are thus very different from those observed with the α-particle. The capture of an α-particle in general leads to the building up of a new nucleus three units heavier than before, while the capture of a neutron leads to the formation of a nucleus three units lighter.

During the past year, Cockcroft and Walton at Cambridge made the important discovery that comparatively low-speed protons are very effective in causing the transformation of a number of elements. The protons are generated in large numbers by an electric discharge through hydrogen, and then speeded up by passing through an evacuated space to which a high potential of the order of 600,000 volts is applied. Under these conditions the protons acquire high speeds comparable with that of the α-particle from radium. When a stream of these swift protons corresponding to a micro-ampere falls on the element lithium, a large number of α-particles are emitted of energy comparable with that of the swiftest α-particle from radium. It seems that about one in 100 million of the protons enters a lithium nucleus of mass 7, and the resulting nucleus of mass 8 splits up into two α-particles, each of mass 4. Cockcroft and Walton have later found that the α-particles emitted consist of two groups differing widely in speed.

This transformation of lithium can be produced at surprisingly low voltages. With strong proton streams, the emission of α-particles can be observed for 30,000 volts; the number of particles increases rapidly with the voltage, and the variation has been examined by different observers over a very wide range, from 30,000 to 1·5 million volts.

Protons are also remarkably effective in disintegrating the light element boron, and again α-particles are emitted. It is possible in this case that the boron nucleus of mass 11, after capturing a proton, breaks up into three α-particles. The radiation observed is complex, and has not yet been analysed in detail. A number of other elements have been found to be transformed, apparently in all cases with the emission of α-particles.

In a special form of accelerating tube devised by Oliphant in the Cavendish Laboratory, a narrow, intense proton stream can be generated at voltages up to 200,000 volts. The protons, after being bent by a magnetic field, bombard a target of about one square centimetre in area. By special arrangements, it has been found possible to obtain in the detecting chamber at least a thousand times the number of particles observed by Cockcroft and Walton at the same voltage. By this method it is easy to observe the particles from very thin films of lithium and boron at comparatively low voltages, while the variation of number with voltage has been measured. For example, a number of α-particles are emitted from lithium with voltages so low as 30,000 volts. α-Particles from boron have been observed at 60,000 volts, but the number increases much more rapidly with voltage than in the case of lithium.

Special experiments have been made to test by this sensitive method whether the heavy elements thallium, lead, bismuth and uranium show any evidences of transformation for 200,000 volt protons, but no sign of emission of α-particles has been observed for these elements. At first, marked effects were observed, but these were ultimately traced to a minute contamination by boron, probably originating in the discharge tube. It seems not unlikely that the effect observed for uranium and lead in the original experiments of Cockcroft and Walton may have been due to an unsuspected contamination by a minute trace of the very active element boron.

During the last few years, much energy has been devoted throughout the world to developing methods of obtaining streams of very swift charged particles with which to bombard matter and effect its transmutation. In the apparatus of Cockcroft and Walton at Cambridge already referred to, a steady potential of 800,000 volts can be reached. A new and simple type of electrostatic generator has been designed by Van der Graaf and Atta in the Massachusetts Institute of Technology, with which they have obtained a steady potential of

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* Substance of the Friday evening discourse delivered at the Royal Institution on March 10.

1·5 million volts, and a larger apparatus is under construction with which they hope to obtain a potential of 15 million volts to apply to a large vacuum tube. Brasch and Lange have applied high momentary voltages to a discharge tube by using an impulse generator.

A new and ingenious method of multiple acceleration has been devised by Lawrence of the University of California with which he has already obtained protons of energy 1·5 million volts by using a potential less than 10,000 volts. The transformation of lithium has been examined at this high energy using a proton current of about a thousandth of a micro-ampere. It is hoped to develop this method so as to obtain protons of energy as high as 10 million volts or more.

Even if these new projects prove successful, the speeds of particles produced by their aid are much smaller than those observed for the very penetrating radiation in our atmosphere, where electrons and protons of energy from 200 million to 2,000 million volts are present. From the experiments of Anderson in Pasadena and Blackett and Occhialini in Cambridge, it seems certain that these very swift particles are very efficient in causing the transformation of nuclei, probably in novel ways. Strong evidence has been obtained of the production of a new type of positively charged particle which has a mass small compared with that of the proton. This may prove to be the positive electron, the counterpart of the well-known negative electron of light mass.

Obituary

DR. C. A. BARBER, C.I.E.

WITH the passing on February 24 of Charles Alfred Barber is severed a link with the past, for he belonged to that old school of scientific investigators who were the first to turn their attention to the problems lying behind development in tropical agriculture. When he gained his first acquaintance with it, there was an awakening to the fact that a harvest does not necessarily follow planting. In the East, Ceylon had gained experience from coffee; in the West, Harrison and Bovell had pointed the way to a healthier growth of cane.

This, as yet dim, appreciation of the need for investigation, led to Barber's first appointment in 1891 as superintendent of agriculture in the Leeward Islands where, however, his stay was brief, for the post was abolished in 1895. In 1898 he was appointed Government botanist, Madras, and, as director of the Botanical Survey of Southern India, commenced to complete the flora of southern India. But here, as in the West Indies, the need for investigation of the economic crops was slowly gaining recognition and his attention was soon diverted to the study of cane and crops in general. These were the days before the Royal Commission of 1896 had led to the establishment of the Imperial Department in the West Indies and before the organisation of an agricultural service in India. It is to Dr. Barber, not least among the pioneers of this period, and to the practical benefits of his work, that the present-day scientific worker in this field largely owes his security in a firmly established service scattered throughout the tropical parts of the British Empire.

During this earlier period, Barber found time to carry out a detailed investigation of the haustoria of sandal and other plants for which he was awarded, in 1908, the degree of Sc.D. of the University of Cambridge. But the earliest economic problem to receive attention was that of the sugar cane disease which was creating anxiety in Madras. In 1912, when the Cane-breeding Station was opened at Coimbatore, the selection fell on him for the post of sugar cane expert, and his field of investigation was extended to cover the whole of India. The problem that faced him was unique. The main cane tract of India lies outside the tropics where, for climatic reasons, the plant forms no viable pollen. Seedlings had to be raised outside the tract and no mean questions of testing and introduction were raised. There was the further fundamental question of the parental type to be used to impart the resistance to frost and drought necessary for success. Through a detailed study of the Northern Indian canes he was attracted to Katha, a hardy Punjab cane, and its similarity to *Saccharum spontaneum*, the wild Kans. He was led to use this wild plant as one parent and, by crossing it with a Noble cane, raised seedlings of which Co.205 remains as testimony to his originality of thought. In its wider aspect his study led him to a classification of the Indian canes, to which he ascribed a dual origin. Again it is a tribute to his insight that this classification, based on a morphological study, has required so little modification from the later Dutch cytological investigations.

Original, too, was Barber's recognition of the importance of the root in the economy of the plant and of the need for a detailed study of the root system. For his services to India he was created a C.I.E. in 1919 on retirement and, in 1931, was awarded the Maynard Ganga Ram prize for Indian research.

Born in 1860 at Wynberg in South Africa, Barber came to England at the age of ten years. After five years' service in the Manchester and Liverpool District Bank, he entered Christ's College, Cambridge, of which he became a scholar. In 1889 he was appointed University demonstrator in botany and, before proceeding to India, served on the staff of the Royal Engineering College, Coopers Hill, where he succeeded the late Prof. H. Marshall Ward.

PROF. JOHAN VAN BAREN

By the death on February 7 of Prof. Johan van Baren, agricultural science has lost the leading authority on soil mineralogy. Born in Rotterdam on April 18, 1875, van Baren became assistant in mineralogy to Prof. J. L. C. Schroeder van der Kolk, of the University of Delft, in 1899. In 1903 he went to Wageningen, where he taught mineralogy and geology at the Agricultural College, and when this College was made an Agricultural University, in 1918, he was appointed professor of mineralogy, geology and agro-geology.

When van Baren went to Wageningen, his facilities for teaching and research were of the most meagre kind, but in the thirty years he spent there he built up a department for his subject which at the present time has no equal. The museum and library, to which he devoted much attention, are particularly fine.

Besides his University work, van Baren had interests in many societies. He was one of the founders of the Geological Society of the Netherlands and Colonies, of the Society for Studying the History of Mathematical and Physical Science, and of the Wageningen section of the Dutch Natural History Society. He was for many years on the Committee of the Royal Dutch Geographical Society, and was a corresponding member of the French Academy of Agriculture. In the International Society of Soil Science he was an active member. He contributed papers to various conferences of the Society and took part in the preparation of the Soil Map of Europe. He devoted much attention to the soils of the East Indian Archipelago, and raised the Junghuhn Fund for the study of these soils.

Van Baren's principal work was a handbook, "The Soil of the Netherlands", in the preparation of which he was occupied for more than twenty years: altogether he published more than a hundred scientific papers. He was particularly interested in the Quaternary deposits of Holland and their correlation with the glacial phenomena of the Alps and Scandinavia. He also studied recent volcanic deposits of the East Indian Archipelago. In soil work he specialised in detailed mineralogical studies, and published a series of memoirs treating of the soils of Holland and the East Indian Archipelago (issued from the Geological Institute of the University of Wageningen). More recently he devoted particular attention to the problems of origin and development of limestone soils under the very contrasting climatic conditions of tropical and temperate regions. In pursuance of his studies he travelled extensively both in Europe and the East.

Van Baren was an inspiring teacher. The writer has vivid and pleasant recollections of an excursion to South Limburg with him and his students in the early summer of 1926—busy days spent in field work, meals taken together at one long table in the hotel at Valkenburg, and discussions and amusements in the evenings. The best of good fellowship existed and when the day's work was done, van Baren joined in the students' concerts with the same enthusiasm as he showed in leading the excursions. A vigorous man of kindly personality, he will be greatly missed by his friends and colleagues in soil science in other countries as well as Holland.

W. G. O.

MR. F. P. BURCH

We regret to announce the death on February 11 at the age of thirty-three years of Mr. Francis Parry Burch. He was the second son of the late Prof. G. J. Burch, F.R.S., of University College, Reading, and was a scholar of Winchester and of Gonville and Caius College, Cambridge, where he took the Natural Science Tripos, Part II (Physics) in 1922.

Burch joined the staff of the Research Department of the Metropolitan-Vickers Electrical Co., Ltd., Manchester, in 1922 as a member of the newly-formed Physics Section, devoting much of his time to the problems of heat transmission, and in the early days of the radio industry he made a careful study of the characteristics of filaments for receiving and transmitting valves. With the development of apparatus for producing electrical transients of extremely short duration, it became necessary to extend the existing facilities for recording these transients, and in conjunction with Mr. R. V. Whelpton he constructed the first high-voltage cathode ray oscillograph in Great Britain. To put the recording of high voltage transients on a sound basis, Burch made a careful study of the theory of the potential divider, completing this valuable work by constructing an apparatus to record transients up to one million volts. Burch then turned his attention to the continuously evacuated power transmitting valve and rectifier, and was largely responsible for the successful completion of a 30 kw. screened grid valve and master oscillator operating at a wavelength of 10 m., the first high power four-electrode valve in the world.

By his death the Metropolitan-Vickers Co. has suffered a great loss, and is robbed of one of its most charming personalities.

We regret to announce the following deaths:

Dr. John Belling, cytologist in the Department of Genetics of the Carnegie Institution of Washington, an authority on the structure of chromosomes, on February 28, aged sixty-six years.

Prof. G. C. Bourne, F.R.S., emeritus professor of zoology and comparative anatomy in the University of Oxford, who did much work on tropical marine fauna, especially on the formation of coral atolls, author of a "Text-Book of Oarsmanship" published in 1925, on March 9, aged seventy-one years.

Dr. R. T. A. Innes, formerly Union Astronomer in South Africa, known for his discoveries and records of binary stars, on March 13, aged seventy-one years.

News and Views

Sir Frank Dyson, K.B.E., F.R.S.

A large gathering, representative of the Admiralty, the Board of Visitors to the Royal Observatory, the staff of the Observatory, the Royal Astronomical Society and the British Astronomical Association, attended a complimentary luncheon to Sir Frank and Lady Dyson on March 10. Affection and respect for the human and lovable chief of astronomy, and for his attainments and achievements, were the note of the letters read from those unable to be present and of the speeches of Prof. F. J. M. Stratton and Dr. W. A. Parr, the presidents respectively of the Royal Astronomical Society and the British Astronomical Association. Tributes were paid to the unselfish yet competent manner in which Sir Frank Dyson has sunk himself in the work of the Royal Observatory during his tenure of the office of Astronomer Royal and to the friendly and helpful way in which he has co-operated with his astronomical colleagues, professional and amateur alike. The best of wishes for the future were expressed to both Sir Frank and Lady Dyson.

Prof. J. Proudman, F.R.S.

Prof. J. Proudman, the present holder of the chair of applied mathematics in the University of Liverpool, has been elected to the chair of oceanography in the University which has become vacant by the death of Prof. James Johnstone. Prof. Proudman joined the staff of the University in 1913 as lecturer in mathematics, and has held the chair of applied mathematics since 1919. In 1919 he was appointed director of the newly founded Tidal Institute and director of Liverpool Observatory. He is a member of the British National Committee for Geodesy and Geophysics and of its sub-committee for Physical Oceanography. He is also a member of the British Section of the International Committee on the Oceanography of the Pacific. He has served on many committees concerned with tidal matters and inundations. His own researches have mainly been concerned with the dynamical aspects of ocean tides and their currents and with the action of wind and of variable atmospheric pressure upon the sea. For his work on these subjects Prof. Proudman was awarded a Smith's Prize of the University of Cambridge in 1915 and the Adams Prize in 1923.

The Californian Earthquake

The earthquake that occurred in southern California at 5.54 p.m. on March 10 (1.54 a.m., March 11, G.M.T.), though it was the cause of considerable loss of life and property, can scarcely be regarded as one of the great earthquakes of that State. The number of persons known to have lost their lives is 151, and it is estimated that 7,500 houses were destroyed or damaged, and that the value of the property lost was more than ten million pounds. Most of the places in which houses were injured lie within an area about sixty miles long, running in a south-easterly direction from near Los Angeles to beyond Santa Ana. The place that suffered most is Long Beach, a town on the coast about twenty miles south of Los Angeles. Here, 65 persons were killed and about a hundred wounded. The epicentre thus lies near the coast, possibly under the ocean, so that the earthquake cannot be connected with the great San Andreas rift, which, in this part of California, runs about fifty miles inland. Since 1769, the Los Angeles district has frequently been visited by severe, though not disastrous, earthquakes. About ninety miles to the west lies Santa Barbara, part of which was seriously damaged by the earthquake of June 29, 1925.

Soviet Expedition to the Pacific Ocean

The expedition to the Pacific Ocean organised under the joint auspices of the State Hydrological Institute and the Ichthyological Institute of the U.S.S.R. has recently returned from the Far East. The expedition made a detailed investigation of the Sea of Japan, the Sea of Okhotsk and the Bering Sea, in which thirty-one members of the Hydrological Institute took part. In the Sea of Japan a thorough investigation was made of the region stretching from the border of Korea to the Gulf of Olta. For the first time in the history of oceanographic research, detailed work was carried out in the parts adjoining the Gulf of Peter the Great at a depth of 8,500 m., and at that depth various organic forms of life hitherto unknown to science were discovered. It has been ascertained that the sharp descent of the coast-line —at an angle of 24°—forms a huge ravine overgrown with tree-shaped corals. One such coral was extracted by the expedition. Samples of the sea-bed at a depth of 8,400 m. have been obtained, and also much hydrological material which makes it possible to determine, according to the seasons, the annual hydrological system of the region of the Gulf of Peter the Great.

Certain inaccuracies of existing maps have been corrected. In some places the depth was found to be 1,000–1,500 m. instead of 100 m.; elsewhere, on the contrary, submarine ridges have been discovered in place of depressions. Much material on hydrology has been collected which point to the penetration of the waters of the Pacific Ocean to the eastern part of the Sea of Okhotsk. In the Bering Sea, hydrological and biological investigations were made, in some places at a depth of 3,800 m. For the first time, the interchange of the water masses of the Bering and Chukhodsk Seas during the summer season was investigated. Numerous measurements were made by the expedition which will enable a more exact map to be made of the western part of the Bering Sea.

Metallurgy Building at University College, Cardiff

In Nature of August 5, 1915, an account was given of the new building which had been erected for metallurgy at University College, Cardiff. An important extension to this building, which completes the scheme, was formally opened on March 16 by Mr. W. D. Woolley, chairman of the Monmouthshire and South Wales Coalowners' Association. The new accommodation provides: ground floor, mechanical laboratory, physical laboratory and lecture room; first floor, three research laboratories, private room, museum and library; second floor, chemical laboratory, balance room, combustion and gas analysis, laboratory and private room. The College has now a well-planned and well-equipped building for teaching and research work, the erection of which is due to the generosity of the Monmouthshire and South Wales Coalowners' Association.

Projected Flight over Everest

IN our issue of February 4 (p. 160), reference was made to the two aeroplanes which have been modified to undertake a flight over Mount Everest. According to the Karachi correspondent of the *Times*, the machines arrived at Karachi on March 9. The main base for the expedition will be Purnea. The photographic results of the flight, should it be successful, are likely to be of considerable interest, for nothing is known at present of the south face of Everest. Indeed, if the photographs are available in time, they may be of assistance to the expedition now in India preparing to climb the mountain (NATURE, Jan. 7, p. 10), especially if the snow and ice conditions have changed considerably since the 1924 expedition. Useful data may also be obtained of atmospheric conditions; while we know a good deal about the atmosphere at 30,000 ft. above mean sea level, it is likely that conditions at this absolute height but with high mountains below will be different. The aeroplanes, however, are not suited for making useful cosmic ray observations. The flight will be a great adventure, for should the machines have to come down through engine failure, the chances of finding a suitable landing place in that great area of mountainous country are small.

Discovery of Sexuality in Plants

THE discovery of sex in plants is usually credited to Camerarius (1694), and Koelreuter (1761) is generally believed to have made the first systematic study of plant hybrids. Statements of Sachs in his "History of Botany" are mainly responsible for these attributions. Dr. Conway Zirkle is able to show, however (*J. Hered.*, vol. 23, No. 11), that other names really have priority in connexion with these important developments in the history of science. N. Grew, in an address to the Royal Society in 1676, expressed the view that the stamens are the male organs of a flower, the pollen acting as vegetable sperm. Thomas Fairchild, whom Sachs referred to as "a gardener in London", was in fact the leading experimenter of his generation, and his famous cross between sweet william and the carnation is shown to have been made at least as early as 1717. Philip Miller was the first to describe insect pollination by observations on tulips. This was not, however, in 1751, as stated by Sachs, but so early as 1721. He also observed natural crossing in cabbages as well as sexual reproduction in cucumbers and melons. Dr. Zirkle also gives an interesting account of equally early American observations on pollination and crossing, chiefly in maize, by Cotton Mather (1716), Judge Dudley (1724) and Governor Logan (1735). A letter of John Bartram in 1739 shows that he too had made species crosses in *Lychnis* at that date.

Courtship of Birds

THE courtship displays of birds, wherein they manifest the amorous emotions which possess them, are now daily becoming more and more assertive. Much has yet to be learned concerning the 'behaviour' of birds thus possessed at this time; and the relation of this behaviour to various and often conspicuously coloured plumage, wattles, bare skin, or inflatable air-sacs. The pheasants afford striking illustrations of apparently conscious effort to display such ornaments to the best advantage before apparently disinterested females. The belief that these displays serve as aphrodisiacs must be regarded as well-founded. This fascinating aspect of bird life can now be studied at the Zoological Gardens, Regent's Park; a number of tragopans, or horned-pheasants, as well as Cheer, Impeyan, and Kalij-pheasants, having just been added to the collections. Blyth's tragopan from Assam, and the crimson tragopan from the south-eastern Himalayas, each bears an erectile appendage over the eye, of a vivid blue colour; and an inflatable wattle at the throat. In Blyth's tragopan this is yellow tinged with blue, while in the crimson tragopan it is orange, barred with blue, and when filled with air presents a strange effect. If the courting antics of the tragopans be compared with those of the golden and Amherst pheasants, wherein the chief ornaments take the form of a great frill of vividly coloured feathers encircling the neck, the contention that both types display deliberate and purposeful movements designed to make the most effective possible use of these ornaments will seem incontrovertible. Though the Darwinian view that these resplendent areas were brought to perfection by the selective preferences of the female, before whom they are displayed, has lost its hold, they are nevertheless instances of 'sexual selection'; since only the most amorous males, the most skilled performers, can succeed in arousing the desired response in their phlegmatic prospective mates.

Vanished Races in South Africa

FROM time to time news is received of the discovery in South Africa of a new and previously unknown culture, presumed to be the work of a vanished race. More often than not the finds are associated with stone-work or the evidence of metal-working. The latest discovery to be reported (*Times*, March 13) comes from the northern Transvaal, where Mr. D. S. van der Merwe, assistant registrar of mining titles on the Rand, has discovered sacrificial graves of an entirely new type, a sacrificial altar, approached by ceremonial causeways and by staircases, an irrigation system of enormous extent, together with the remnants of a large dam. There is also a copper tool, which is said to be an authentic mining implement. These finds are ascribed to a vanished race, and on account of the diminutive size of the stairways, it is suggested that its members were pygmies. The collections have been placed at the disposal of the Ethnological Department of the University of the Witwatersrand and are said to be regarded by the Department as very important. As Mr. van der Merwe is a layman in ethnological matters, the verdict of experts in the cultures of the natives of South Africa will be awaited with interest. As a rule, unfortunately, previous claims to the discovery of new cultures and vanished races have not survived their impartial scrutiny.

A New South African Culture?

A CLAIM to have distinguished a new material culture in South Africa is put forward by Dr. Ir. E. C. N. Van Hoepen, director of the National Museum, Bloemfontein (*Argæologiese Navorsing*, Dl. i St. 5), in describing a remarkable stone pipe from a shelter near Bethlehem. Its peculiarity lies in the ornamentation, a system of curved grooves and on one side a sinuous ridge ending in a reversed E, representing a snake. Similar pipes have previously been described, one of clay from the ash-heaps of stone huts at Vegkop by Van Riet Lowe and another of stone by Stow. Van Riet Lowe attributed the pipe he described to the Leghoya, dating the huts at about 1790, but Dr. Van Hoepen does not consider his reasoning or evidence satisfactory, and points out that stone huts are not a characteristic of Bantu culture, the Leghoya themselves using conical grass thatched huts, according to Stow. He himself sees in the pipes and the shelters closer affinities with Hottentot, Bushmen, and Xosa, but concludes that the three characters, the stone pipes, the stone huts and the ornamentation do not belong to any known African culture. We are, therefore, he holds, dealing with something new, a culture for which the name 'stone-hut' culture is proposed. This view, important as it is for the history of South African cultures, should be accepted with some caution. Its confirmation by further evidence will be awaited with interest.

American Archæologists in Yugoslavia

AT a meeting of the American Anthropological Association held in Atlantic City at the end of December, Dr. Vladimir J. Fewkes described the work during the past summer of a joint archæological expedition of the Peabody Museum, the Fogg Art Museum, Harvard University, and the American School of Prehistoric Research in Jugoslavia. Some 150 archæological sites were visited and examined. A large proportion of these were found to belong to Greek, Roman, Macedonian or Byzantine cultures. The most considerable undertaking of the expedition was the excavation of the neolithic site at Starcevo, of which the investigation had been begun in the previous year. The settlement is dated at about 2500 B.C. and is found to consist of a number of irregularly placed groups of semi-subterranean dwellings, of which the foundations have been exposed. Among the material found are crude but well-made cooking pots, painted pottery, needles, awls and spatulas of bone, stone knives and celts, shells, and small libation tables of baked clay. The settlement was one of small farmers with domesticated animals, who supplemented their food supply by hunting and fishing. In a report of the communication from Science Service, Washington, D.C., Dr. Fewkes is said to have stated that the expedition had gathered fresh evidence relating to the early trade routes of this part of Europe, an area he regards as the archæological key-region of the Balkans.

Spectrum Analysis

THE increasingly great interest now being shown in spectrum analysis is well exemplified by two recent developments in the United States. The first of these was the setting up by the American Society for Testing Materials of a committee (E-2) on spectrographic analysis in its application to analytical and metallurgical problems. This committee is now at work and it is probable that tangible results will be forthcoming in the near future. News of the second development has just reached Great Britain. It has been decided that one of the lines of work to be intensively pursued at the magnificently equipped spectroscopic laboratory of the Massachusetts Institute of Technology is the application of spectrum analysis to industrial and related problems. In order that as close touch as is possible may be made with industrial problems, a research conference is to be held at the Institute during the week beginning July 17, and it is hoped that at this conference industrial experts, academic research workers and manufacturers of spectroscopic equipment will meet and discuss those aspects of the problem with which they are individually familiar. It is clear that one of the earliest developed aspects of spectroscopy is again coming very much to the fore, and that the dreams of some of the early spectroscopists regarding the general use of this technique in industry are coming measurably nearer realisation.

Machine Age's Starvation Predicted

THE comparatively rapid depletion of the earth's available resources in this mechanical age was considered by Prof. R. A. Gortner, of the University of Minnesota, in a paper before the American Association for the Advancement of Science in December (Science Service, Washington, D.C.). It is pointed out that irreplaceable stores of natural resources absolutely essential to modern industrial civilisation are disappearing into the 'maws of industry' and so are wastefully dissipated over the earth. While the publicity of technocracy directs attention to the part played by mechanical energy in remaking economic conditions, the shelves in some of Nature's cupboard are showing signs of exhaustion of the materials necessary for a mechanical age. In particular, Prof. Gortner mentions the approaching exhaustion of copper, antimony, tin, lead, zinc, chromium, manganese, nickel and iron, which are stored in parts of the earth accessible to man. The rate of use of some of these metals is doubling each decade. We still use tin-foil for wrapping up sweets and cigarettes. At the present mining rates, iron will be exhausted in Germany in about fifty years and in the United States in about a hundred years. The supply of sulphur in the United States will fail in fifteen years, the coal of Germany in less than a thousand years and of the United States, notwithstanding its huge lignite deposits, in less than fifteen hundred years. It looks as if the machine age may starve to death before long, a victim of to-day's profligate use of metals, coal and oil. Water power, alcohol from vegetation, solar energy, etc., are at present totally inadequate to replace oil and coal. Will future civilisations look back upon the industrial civilisation of the twentieth century as an age of robbery?

U.S. Bureau of Standards

The annual report of the Director of the Bureau of Standards (Government Printing Office, Washington, 1932) shows the trend of scientific developments during last year. The increase in the industrial applications of very low temperatures has made it advisable to extend the scale downwards from −100° C. to −259° C. and a temporary scale covering this range has been established. Fire tests have been made on the new welded steel floors which are now being used in buildings. They consist of steel floor plates welded to beams spaced two feet apart. Tests were made with fire both above and below the floor. Gas appliances found quite satisfactory at sea level develop defects when used in cities at high altitudes. The causes of these defects are being investigated. Perhaps the most spectacular advance made during the year has been to increase the accuracy of the primary frequency standard to one part in ten million. Regular transmissions of standard high-frequency waves at a frequency of 5,000 kilocycles per second are broadcast every Tuesday for four hours. The accuracy obtained is one cycle per second, that is, one part in five million. The ionised layer in the atmosphere has been determined to be the major controlling factor in the long distance transmission of radio waves. The measurement of the height of this layer is of primary importance in interpreting transmission conditions and increasing our knowledge of radio wave transmission. Using improved equipment, these measurements were made on one day in each week throughout the year. An automatic recorder is now in use which makes continuous measurements. Useful work is done in making careful analyses of samples of ores, alloys, pure metals, cement and pure chemicals. These samples are sold to industrial laboratories and are used for checking their own methods and results. This plan has contributed greatly to the precision of the analytical work in these laboratories and the project is self-supporting.

Miners' Nystagmus

Two reports on this subject by a Committee of the Medical Research Council were issued in 1922 and 1923. The principal finding of the Committee was that the chief symptom of this disease—the involuntary oscillation of the eyeballs—is caused by an insufficiency of the light reaching the eyes of the miner while at work, and that the most important measure of prevention is to secure for the miner at work adequate illumination. Nevertheless, in spite of considerable improvement in the illumination of mines, the incidence of the disease has, on the whole, steadily increased, for compensation on account of this disability was paid to 10,638 persons in 1930; this is the largest number, with one exception, during the past twenty-three years. The Medical Research Council has therefore considered it advisable to reconstitute the Committee, which has now issued a third report on the subject (Special Rep. Series, No. 176. H.M. Stationery Office. 9*d*.). This reaffirms, in the strongest terms, the conclusions of the former committee. There should be constant illumination of 0·25 foot-candle on the coal face, and it is understood that there are recent developments in the direction of improving illumination in mines. To account for the continued prevalence of the condition, it must be recognised that the oscillation of the eyeballs is but a part of the disease, and various psychoses and neuroses are also present. The practical treatment of the disease should consist in the elimination of a hopeless dependence on compensation by the provision of opportunities for work of some kind, even if restoration of full work underground has to be preceded by a period of work in daylight.

Guard Posts for Road Island Refuges

Illuminated guard posts or 'bollards' are now gradually coming into use on all types of roads which carry fast vehicular traffic. In the *Osram G.E.C. Bulletin* for February, a description is given of a well-designed guard post which should prove useful not only by indicating the refuge to pedestrians, thus prompting them to cross the road at that point, but also to motorists; thus removing a frequent cause of accidents. It is a luminous pillar 4 ft. high, the light being emitted only from the side which faces the traffic. The back of the pillar is made of solid steel tube, so that in the event of a smash the damage done will be probably much less than if it were made of cast iron. The head of the bollard is arranged as a lantern with the red glass fixed around half its circumference. The red glass is generally illuminated by a sixty-watt lamp but sometimes a small auxiliary lamp is used as well so as to prevent a complete 'black out' if the main lamp is extinguished. Complete isolation of the bollard from the electric supply in the event of damage is easily obtained by opening a door near the ground level where the time-switch and fuses are fixed.

Researches on Sedimentation

The report of the Committee on Sedimentation for the two years 1930–1932 has been published under the auspices of the Division of Geology and Geography of the U.S. National Research Council as National Research Bulletin No. 89, 1932 (pp. 229, price

1 dollar). The report is by the chairman, Prof. W. H. Twenhofel, who contributes a general introduction, and various committee members and others, who are responsible for many valuable records of original research and abstracts of literature on the accessory minerals of igneous and sedimentary rocks. Special attention deserves to be given to the paper on the classification and terminology of the pyroclastic rocks by C. K. Wentworth and Howel Williams. The Bulletin also includes papers on recent advances in the study of peat; recent marine sediments; settling of bentonite in water; relation of the buffer mechanism of sea water to the solubility of calcium carbonate; modern marine sediments in California; bacterial and chemical factors in lime deposition at Tortugas, Florida; varved sediments; chert and flint, concretions, and cone-in-cone; abrasional work of river ice and of glaciers; ground water hydrology in its bearing on sedimentation; rôle of micro-organisms in sediments; accessory minerals of crystalline rocks; and glacial sediments. In addition, there are summaries of work on sedimentation carried out at Stanford University, and also of recent work by German and British investigators; and abstracts of the literature on accessory minerals of igneous rocks and of sedimentary rocks.

Developments in Market Gardening

THE report of the recent conference on "Recent Developments in Market Gardening" held at Rothamsted contains a great deal of information which is not readily available in a collected form. Two of the classical market garden areas, the Bedfordshire early potato and brussels sprouts district and the equally well-known spring cabbage, brussels sprouts and fruit area of Evesham are treated in detail from the point of view of the practical grower, and the subject is also considered from the point of view of the canner, whose part in the industry is becoming increasingly important. In recent years market gardeners have found their province invaded by large-scale farmers, who have in part substituted vegetable growing for the less profitable crops of their ordinary rotation. These men, whose methods form the subject of one of the papers, have several advantages not possessed by the smaller cultivators; plentiful animal manures, large-scale mechanical methods, and a possibility of converting unsaleable surplus into live stock products. The reply of the genuine market gardener has been to move towards greater intensification, and to retire into districts as yet inaccessible to large-scale methods. The conference as a whole leaves the impression that abundant production of market garden crops is relatively easy to secure. It can in fact be an embarrassment, and every additional outlet whether by preservation, more economical distribution, or the education of the public taste, needs careful investigation. Copies of the report, price 2*s*., can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

Institute of Industrial Administration

IN a pamphlet recently issued by the Institute of Industrial Administration, 47 King William Street, E.C.4, outlining its objects and examinations, it is stated that management in industry is essentially the exercise of administrative function and involves the control and co-ordination of the technical functions. The operation of the administrative function does not vary greatly from one industry to another despite differences in the application of some of the technical functions, especially that of production. It is admitted that personality is a highly significant factor in industrial administration but training serves both to develop and inform personality. To the average individual upon whom industry has mainly to rely, training may make all the difference in his efficiency, to his own advantage and that of the nation. In preparing a revised syllabus of examinations, the Institute has endeavoured to collate the principles and practice bearing on the functional aspects of industrial administration. The scheme consists of three stages—fundamentals, intermediate and final—the first of which presents in elementary form a general idea of how an industrial undertaking is conducted and its relation to external affairs. In the intermediate and final stages the subjects of the fundamental stage are extended and amplified.

Physics at Harvard

VOL. 21 of Contributions from the Physical Laboratories of Harvard University consists of separate copies of the papers by members of the staff and other research workers which have appeared in the *Physical Review*, the *Proceedings* of the National Academy of Sciences and of the American Academy and other periodicals during 1930–31. There are forty of them, which differ considerably in type and area of the letterpress, but are all cut to pages 9¼ in. × 6¾ in. Their subjects extend over almost every branch of physics and they testify to the catholicity and quality of the research work done at Harvard. The completion of the new research laboratory and the improvement of the Jefferson Laboratory during the period covered by the volume afford a suitable opportunity for a 47-page illustrated description of the present buildings and equipment, and a short history of their foundation and of the work done in them, and in the Cruft Laboratory. Nearly 130 men have carried on research in the laboratories during the last thirty years and many of them now fill chairs of physics in American universities.

Mining Facilities in South Australia

ACCORDING to the annual report of the Director of Mines and Government Geologist of South Australia for 1931, an amending act was passed during the year concerning principally mining upon lands, beneath which mineral substances had been alienated prior to the adoption of the principle of reservation of such substances. The act protects land-owners, but under certain conditions allows prospectors to enter such lands under reasonable conditions; the responsibility for seeing that such an authority is not given to an undesirable character is placed upon the Warden.

Anatomy of the Tortoise

THE attention of teachers and students in vertebrate anatomy who include the tortoise in the list of the animals they study by dissection, is directed to an account of the anatomy of that animal published by the Royal Dublin Society (vol. 20, No. 28, Dec. 1932). The late Dr. J. Stuart Thomson was engaged on the preparation of this memoir over a number of years with the view of providing an account of the principal structural features of the tortoise for his own and other senior students. The descriptions, in about eighty pages, of the external characters and the various systems of organs are systematic, clear and adequate, and are supported by twenty-five well-drawn plates. This useful paper is published at the reasonable price of 8*s*.

Land Utilisation Survey

THE second annual report of this survey of Great Britain records that thirty-one counties are now completed or very nearly completed, comprising nearly 8,700 sheets. More than a third of the area of the country is covered by these maps. Compared with the previous year, progress has been rapid. Thirty-six counties, during the last year, have undertaken work for the survey and there are now only four counties in which nothing or very little has been done, namely Essex, Carmarthen, Argyll and Perth, but considerable help is still needed in the West Riding of Yorkshire outside the completed Sheffield area. The director of the Survey also asks for the assistance of volunteer workers in the counties of Somerset, Westmorland, Wiltshire, Peebles, Inverness and Sutherland. Work on the reduction of the results to a scale of one inch for publication is proceeding actively on several sheets in England and Scotland, including Cromer, Ipswich, Ullapool and Liverpool.

Announcements

PROF. P. Debye will deliver the fifteenth Faraday lecture before the Chemical Society on March 29, at 5.30, at the Royal Institution, Albemarle Street, W.1. The lecture will be entitled : "The Relations between Stereochemistry and Physics".

THE memorial fund instituted in memory of Dr. R. Stenhouse Williams, formerly director of the National Institute for Research in Dairying (University of Reading) to which reference has already been made in our columns, has now reached a total of £1,800. It is proposed to close the fund shortly, but further contributions will be welcomed. The fund will be used for the advancement of dairy science at the National Institute for Research in Dairying.

A SERIES of five talks by Mr. Charles Elton, director of the Bureau of Animal Population at the University of Oxford, on "Exploring the Animal World", will be broadcast by the British Broadcasting Corporation on Friday evenings commencing on April 21. During these talks, co-operation will be sought between the amateur observer and scientific worker, especially in the second talk on "Woodland Life", when listeners will be asked to help in a survey of the birds of different kinds of woods all over England.

WITH reference to the note on "Illuminated Fountains" which appeared in NATURE of March 4, p. 302, Mr. A. S. E. Ackermann has pointed out that an article by him on an illuminated fountain at the Barcelona Exhibition appeared in the *Journal and Transactions of the Society of Engineers* (21, No. 3, 115 ; 1930). In this fountain there were 750 incandescent lamps of 2,500 candle-power, besides arc lamps. Photographs of the fountain in action are reproduced.

WE regret to learn that a serious error occurs in the description of the 'soil conductivity bridge' by the Cambridge Instrument Co., Ltd., advertised in the Supplement to NATURE of March 11, p. iv. This should read : "This A.C. Bridge will measure directly the specific resistance of samples of soils ; the reciprocal of the reading being taken as the specific conductivity in mhos per cm.^{3}. The range is from 1 to 100,000 ohms, or 1 to 10^{-5} mhos." The term 'mhos' (reciprocal ohms, measuring conductivity) was altered without authority by the printer to 'ohms', after the proof had been passed for press by the advertiser.

MESSRS. HOPKIN AND WILLIAMS, LTD., 16 Cross Street, Hatton Garden, London, E.C.1, have issued a useful booklet of 60 pages, price 1*s*., entitled "Organic Reagents for Metals", in which working directions are given for the use of sixteen organic reagents, such as picrolonic acid and quinalizarin, which have become important in analytical chemistry in recent years. Improved details are given for some of the methods, and a comprehensive bibliography is appended for each reagent.

APPLICATIONS are invited for the following appointments, on, or before, the dates mentioned :—A registered medical practitioner with experience in bacteriological research for the Ministry of Health—The Director of Establishments, Ministry of Health, Whitehall, S.W. (March 27). An assistant lecturer in bacteriology in the Edinburgh and East of Scotland College of Agriculture—The Secretary, 13 George Square, Edinburgh (April 7). A principal investigator for the Burden Mental Research Trust—The Secretary of the Trust, B.M.A. House, Tavistock Square, London, W.C.1 (April 10). An independent lecturer in materia medica and pharmacology in the Welsh National School of Medicine—The Secretary, Welsh National School of Medicine, The Parade, Cardiff (April 25). A woman assistant demonstrator in physics in the Royal Holloway College (University of London), Englefield Green, Surrey—The Principal (May 10). An assistant lecturer in mechanical engineering in the Battersea Polytechnic, London, S.W.11—The Principal.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Scientific Centralisation in the British Empire

THE leading article entitled "Ottawa and After", in NATURE of October 8, 1932, concludes with an interesting comment on higher education in the Dominions. I can speak with first-hand knowledge of conditions in New Zealand and Australia, and feel that there is a greater fundamental difficulty than the existence of a superior climate which is more conducive to outdoor life. The difficulty is an Imperial one. The Empire is centripetal, not centrifugal, and the tendency is to look to England as the only place where the best may be encountered, or the best work carried on. This influences educational outlook from the secondary schools to the universities, and the public, despite crudely nationalistic tendencies on the parts of some lesser journals, sees greener pastures in all branches of culture, in distant Albion.

Add to this the fact that Dominion universities are primarily concerned with professional training, in the present stage of development of these lands, and it becomes clear that the inducement to attract and retain good men in professional posts involves more than might be supposed. The old-established scientific societies with all their tradition and prestige, their facilities for publication and criticism of original work, and their influence in paving the way to higher posts, are in Great Britain.

The personal contacts made and maintained at meetings of the societies are of inestimable value in fanning the flame of original work. Just as the 'hungry forties' were the driving force in colonisation, so the underpayment of university assistants in the nineteenth century led them to posts in Australia at salaries far beyond their reach for many years had they remained in England and Scotland. But, just as it has become safer for the workers to remain in England, so is it with the professor's assistant, who now cannot be so readily induced to accept a professorial salary of £1,100 in Australia, with a sacrifice of the advantages of scientific centralisation, advantages greatly enhanced by the establishment of medical and industrial research subsidy under the ægis of the scientific societies.

It has long been my conviction that it rests with the better men of the Dominions themselves to save the outer Empire from the intellectual anæmia which highly centralised intellectual advantage and prestige must necessarily provoke. After their post-graduate years in England they must resist the almost overwhelming temptation to accept posts in the British Isles, and must, when opportunity offers, return and fight their lonely battle for its own sake.

Unless and until this happens our claim to Imperial greatness must remain open to question, for otherwise all our technical and governmental skill will have been directed to purely material ends, and the term 'Commonwealth of Nations' must remain a hollow sham.

C. STANTON HICKS.

University of Adelaide.

The Oldoway Human Skeleton

WE should be grateful if the following statement on the question of the age of the Oldoway human skeleton could be published in NATURE.

One of us (L. S. B. L.) brought back to England a large series of samples of the different strata which were collected not only from the region of the 'man site' but also from widely separated points, up and down the Oldoway Gorge. These samples have now been examined at the Imperial College of Science and Technology by P. G. H. Boswell and J. D. Solomon. The following conclusions emerge from their study.

(1) The materials of Beds II and III appear to be very similar to each other so far as their mineral constitution is concerned, but they can both be clearly distinguished from the materials of Bed IV and also from Bed V.

(2) The material of Bed V is so distinctive in its mineral content that it can be immediately distinguished from any of the four lower beds.

(3) Thin layers of steppe-lime, which in places occur at the base of Bed V, are not distinguishable with certainty from the steppe-lime which forms the top part of Bed V.

(4) The thin red-coloured deposit which is present in the section of the 'man site' overlying Bed II and underlying Bed V is a hillwash material in which the characteristic minerals of Beds IV and V occur.

(5) Samples of Bed II, actually collected at the 'man site', at the same level and in the immediate vicinity of the place where the skeleton was found, consist of pure and wholly typical Bed II material, and differ very markedly from the samples of the matrix of the skeleton which were supplied by Prof. Mollison from Munich.

Following from (4) above, it is clear that erosion had removed from the region of the 'man site' the whole of the overlying Beds III and IV before the hillwash, formed during the last stages of this process, was deposited and afterwards covered up by the formation of Bed V. Thus, at some stage before the deposition of Bed V in this area, the top of Bed II was exposed as a land-surface with a thin mantle of hillwash material.

We may further note that all of those who have examined the section at Oldoway are agreed in the opinion that the Oldoway skeleton cannot reasonably be regarded as having been buried after the deposition of Bed V proper, and of the steppe-lime which covers it.

One of the reasons which caused one of us (P. G. H. B.) in his letter in NATURE of August 13, 1932, to suggest a post-Bed V date, was the presence of small pieces of steppe-lime in the matrix sent from Munich. He was not then aware, however, of the presence of steppe-lime below Bed V, as mentioned in (3) above, so that there is now no necessity for upholding this view.

In order that the important question of the age of the skeleton shall be established on as sure a foundation as possible, the evidence outlined above will be supplemented by the results of a further examination, by Reck and his colleagues, of rock collections from Oldoway and the volcanic highlands to the east. Meanwhile, on the basis of the evidence summarised above, it seems highly probable that the skeleton was intrusive into Bed II and that the date of the intrusion is not earlier than the great unconformity which separates Bed V from the lower series. On the other hand, it seems certain that the skeleton was deposited where it was found before the main mass of Bed V and the overlying steppe-lime were formed, that is, the skeleton appears to have been buried at the time of the existence of the old land surface connected with the steppe-lime at the base of Bed V.

It so happens that there is other and independent evidence which supports this view. On this old land surface, and also in the basal deposits of Bed V, there was found an industry which has very close affinities with the phase C of the Upper Kenya Aurignacian. From the work at Gamble's Cave in 1929, we know that the men of this culture-stage buried their dead in the contracted position, as was the case with the Oldoway skeleton. It seems likely, therefore, that the Oldoway man was one of the race which made the tools that are found on the old land surface and in the basal deposits of Bed V.

The above views accord with those of Mr. E. J. Wayland, director of the Uganda Geological Survey, summarised in letters to NATURE (October 15, 1932) and *East Africa* after his visit to Oldoway last August.

L. S. B. LEAKEY.
H. RECK.
P. G. H. BOSWELL.
A. T. HOPWOOD.
J. D. SOLOMON.

Heights of Nuclear Potential Barriers and Nuclear Structure

I RECENTLY pointed out in these columns[1] that experimental evidence indicates that the heights of the potential barriers of the light nuclei are proportional to the atomic number. This simple relation can be shown to fit in with Heisenberg's suggestion[2] that nuclei are composed of protons and neutrons and that there is an attractive force $J(r)$ between neutron and proton at close distances, and between neutron and neutron $K(r)$, the former being the greater. An α-particle contains two neutrons and two protons, a nucleus contains n_1 neutrons and n_2 protons; there will therefore be an attractive force between nuclear neutrons and α-particle protons *and* nuclear protons and α-particle neutrons, superposed on the Coulomb repulsion between protons. Thus we have (neglecting the neutron-neutron force $K(r)$, since it is less than $J(r)$):

$$V = \frac{2n_2e^2}{r} - \frac{2n_1k}{r^p} - \frac{2n_2k}{r^p}$$

for the potential at a distance r. I have assumed a law of force of the form $\frac{k.\, n_1.\, \text{no. of protons}}{r^p}$ to represent $J(r)$.

This gives

$$V = \frac{2n_2e^2}{r} - \frac{2k(n_1+n_2).}{r^p}$$

It happens that for the light elements n_1 is very nearly equal to n_2, never differing by more than one unit. Thus we have approximately,

$$V = \frac{2n_2e^2}{r} - \frac{4kn_2.}{r^p}$$

This gives for V_c the maximum when $dv/dr = 0$ the value

$$V_c = \frac{2n_2e^2}{(2pk/e_2)^{1/(p-1)}}\left[1 - \frac{1}{p}\right]$$

If p is constant, that is, if the law of force is the same from element to element, we have that V_c is a straight line function of n_2, which is what is found experimentally.

The critical radius for the height of the barrier is $(2pk/e_2)^{1/(p-1)}$ and has, for elements for which n_1 is approximately the same as n_2, a constant value; this would be expected, because both repulsive and attractive forces increase linearly with the nuclear charge. This critical radius does not necessarily govern the volume of the nucleus. An accurate measurement of the barrier heights would afford a means of testing the truth of the assumption made by Heisenberg (and necessary to his theory of nuclear stability) that the neutron-neutron force is less than the neutron-proton force; since if it were not so, the attractive force would depend on n_1 alone, giving different values for those elements (such as lithium and beryllium) for which n_1 does not equal n_2.

The heights calculated for these two elements (both subject to considerable error) do fit in better with an attraction proportional to $n_1 + n_2$ than to n_1. It is interesting to note that the attractive force in the case of a proton does depend on n_1 alone, so that the barrier height to a proton should be rather higher than half that to an α-particle for light elements: for heavy elements, where the number of neutrons is roughly twice the number of protons, the barrier will not rise so rapidly; perhaps this accounts for the relative ease of penetration of heavy nuclei by fast hydrogen ions.

Since the slope of the line relating height and nuclear charge depends on p, the index power of the law of force, it should be determinable from this relation.

E. C. POLLARD.

Physics Laboratories,
University of Leeds.
Feb. 2.

[1] E. C. Pollard, NATURE, 131, 97, Jan. 21, 1933.
[2] W. Heisenberg, *Z. Phys.*, 77, 1; 1932.

Arc Spectrum of Iodine

THE analysis of the spectrum of the normal iodine atom has proved relatively difficult, partly because of the wide multiplet separations, and partly because of the transitional nature of the coupling characteristics. Some constant intervals, due to Turner[1], have long been known, and S. F. Evans[2] in 1931 presented a partial analysis which included most of the stronger lines in the region 4700–10000 A. Recently S. C. Deb[3] has published a more extensive analysis, which differs very materially from that of Evans. As he dismisses the latter's results rather summarily, with the remark that they are "mainly incorrect", some observations on his paper may be of assistance in forming a just appreciation of the present position in regard to this question.

In the first place, it may be noted that of the 160 wave-lengths listed by Deb, 75 are identical with those given by Bloch[4] and 19 with those of Evans, although the text implies that they are his own determinations. Further, Bloch classifies all but 9 of these 75 as spark lines, and Evans's observations (unpublished), together with those of Wood and Kimura[5], are in good general agreement. The multiplets proposed take no account of this heterogeneity of the data, including arc and spark lines on an equal footing. It is therefore not surprising that the multiplet intervals show much wider discrepancies than should be permissible by reason of wave-length inaccuracies. As one instance we may take the interval 1459·3 cm.$^{-1}$ which was well established by

Evans on the basis of five values lying within a range of 0·3. Deb's values for this vary from 1451·6 to 1459·5, with a mean of 1455·5. It is clearly essential in work of this kind, first to obtain a homogeneous set of data of the highest possible accuracy, and secondly to accept as significant only those intervals which agree within the order of accuracy of the data. The work under consideration fulfils neither of these requirements.

Again, the evidence obtainable from hyperfine structure work[6] is entirely neglected by Deb, and in fact is only in occasional agreement with his allocations of *j* values, although it is in harmony with Evans's observations.

Finally, Deb's value for the ionisation potential, 10·548 volts, is open to serious question. It is based on a very doubtful interpretation of an emission continuum with a maximum at 3406 A.; this is presumably that commonly known by the wavelength 3460 A. of its less refrangible edge. He attributes it on very slender evidence to the capture of an electron by an iodine atom in the $5p^4.6s.{}^2P_{\frac{3}{2}}$ state. The evidence against this interpretation need not be detailed here, but it is of a very convincing character. Although several Rydberg sequences are given they do not lead as usual to independent values of the ionisation potential, since the term values involved are based on the above assumption; neither can they be regarded, in view of various objections to them which can be raised, as affording any support to that assumption.

In view of these criticisms I am bound to say that our knowledge of the structure of the iodine spectrum does not appear to have been sensibly advanced by the paper under consideration.

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Feb. 27.

W. E. CURTIS.

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[1] Turner, *Phys. Rev.*, **27**, 397; 1926.
[2] Evans, *Proc. Roy. Soc.*, A, **133**, 417; 1931.
[3] Deb, *Proc. Roy. Soc.*, A, **139**, 380; 1933.
[4] Bloch, *Ann. Phys.*, 11, 141; 1929.
[5] Wood and Kimura, *Astrophys. J.*, **46**, 181; 1917.
[6] Tolansky, *Proc. Roy. Soc.*, A., **136**, 585; 1932.

Line Absorption of Chromic Salts in Relation to Co-ordination

THE absorption spectra of salts of trivalent chromium are characterised by exceedingly narrow bands in the red part of the spectrum. Their presence in the spectra of co-ordination compounds of chromium was discovered by Lapraik[1] in 1890, whose work is the more remarkable for being completed prior to Werner's theory of co-ordination valency and therefore at a time when the peculiar structure of the compounds was unknown.

We have recently examined the aqueous solutions of a number of chromic compounds by means of a spectrometer and have noticed a very simple fact which would doubtless have been missed had we used a spectrograph. In the case of every compound studied, only *one* narrow band is sufficiently strong to be detected by visual observation of dilute solutions in short observation tubes. In many cases it is as persistent as the neighbouring broad 'molecular' absorption band, for on dilution both disappear at about the same concentration. For convenience we shall refer to this narrow band as the 'characteristic band' of the compound.

An interesting relationship has been established between the chemical constitution of a complex ion and the position of the characteristic band. It is evident from the accompanying table that as the three electrically neutral molecules of ethylene diamine (en) in $[Cr(en)_3]^{+++}$ are successively replaced by negatively charged oxalate radicles, the band moves farther into the red. The position of the characteristic band of a complex ion is sensibly unaffected by the accompanying anions or cations.

Molecular Ion	Approximate Position of Characteristic Band.
$[Cr(en)_3]^{+++}$	6705 A.
$[Cr(en)_2 C_2O_4]^{+}$	6845 A.
$[Cr(en)(C_2O_4)_2]^{-}$	6915 A.
$[Cr(C_2O_4)_3]^{---}$	6970 A.
$[Cr(H_2O)_6]^{+++}$	6695 A.

The condition of chromic ion in violet solutions of the simple salts is, presumably, $[Cr(H_2O)_6]^{+++}$, and the nearness of its characteristic band to that of $[Cr(en)_3]^{+++}$ is noteworthy. When a solution of chromic sulphate is boiled, sulphate ions displace water molecules from the complex and the green colour is thought to be due to $[Cr(H_2O)_4 SO_4]^{+}$. We find the characteristic band of the green solution appears, much broadened, at about 6820 A., which is in qualitative agreement with this point of view. Similar results have also been obtained with green solutions of chromic chloride in which one or more chloride ions have entered the co-ordination sphere.

We consider that the bonds uniting ethylene diamine and oxalate radicles to chromium are predominantly, though not purely, covalent, since all these complex ions can be resolved into pairs of optical isomers[2]. The presence of extremely narrow bands in their spectra is at first sight surprising, since such bands are usually associated with electron transitions in free ions, as for example, those of certain rare earth metals[3]. However, the phenomenon is quite in harmony with Linus Pauling's 'model' of the molecular ion[4], for *even when co-ordinated*, chromic ion possesses three unpaired electrons and it may be supposed that the absorption of a quantum of red light produces an excited state in which the spin moments of two of the electrons cancel one another, the multiplicity being thereby reduced from four to two. Thus arises the possibility of pure electron transitions in a covalently linked molecular ion. On the other hand, the co-ordination compounds of cobaltic ion contain no unpaired electrons and no unoccupied 3*d* levels, so electron transitions of the type described above are clearly impossible. Certainly we have been unable to discover any narrow bands in the absorption of $[Co(en)_3]^{+++}$, $[Co(C_2O_4)_3]^{---}$ or $[Co(CN)_6]^{---}$ within the visible spectrum.

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A. MEAD.

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Feb. 7.

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[1] *J. prakt. Chem.*, **47**, 305; 1893.
[2] Johnson, *Trans. Far. Soc.*, **28**, 845; 1932.
[3] Freed and Spedding, *Phys. Rev.*, **34**, 945; 1929.
[4] *J. Amer. Chem. Soc.*, **53**, 1367; 1931.

Mycorrhiza in the Genus *Citrus*

RECENT experiment points to a close and direct correspondence between the incidence and character of mycorrhizal infection and differences in the rooting medium. In view of the existence of mycorrhiza as a regular phenomenon in many crop plants, it appears likely, therefore, that intensive study of the soil conditions controlling its development may be a matter of practical importance to growers.

Although experimental research in the hands of a few specialists has yielded and continues to yield remarkable results for certain specialised groups, ignorance is still profound in respect to the significance and control of the widespread and apparently relatively unspecialised mycorrhiza known as the 'Phycomycete type'[1]. Recorded in an immense number of wild herbaceous species belonging to the most diverse families and from the most varied habitats, and also in a few trees, mycorrhiza of this kind has been observed in certain crop plants of economic importance; for example, strawberry[2], sugar cane[3], wheat[4], and the lychee[5]. It is of some interest, therefore, to place on record its existence in the genus *Citrus*; both in the sweet orange, *C. sinensis*, and the sour orange, *C. aurantium*, in the orchards of southern California. Previous records for the genus from Italy are fragmentary and unsatisfactory[6].

The roots of the cultivated orange are remarkably poor in root hairs, especially when grown in the neutral or alkaline soils of California. As observed in roots of trees from the experimental field plots at this Station, there is a regular and quite characteristic distribution of mycelium bearing large 'vesicles' in the young roots, involving inter- and intracellular infection with periodic digestion of the intracellular system of hyphæ and their contents.

Since oranges and other citrus fruits are cultivated under highly artificial conditions in California and elsewhere, it will be of interest to learn whether there is a similar type of root infection in the species used as stocks when growing wild in their native habitats.

The practical significance of the problem lies in the importance of nitrogenous manures in *Citrus* culture in California, where some form of this element is practically the only fertiliser employed. Experience has shown that nitrogen supplied as sodium nitrate or similar inorganic compounds gives poor results, whereas sodium nitrate treatments combined with stable manure or rapidly decomposable organic matter in the form of cover crops are highly beneficial.

No adequate explanation of these differential results has yet been offered, and the discovery of this type of mycorrhiza suggests that the organic materials supplied to the soil furnish appropriate food for the root fungus and provide the conditions requisite for root infection, a proportion of the metabolised products passing eventually to the root cells during the regular and extensive digestion of intracellular mycelium.

The application of pure culture methods to the problems presented by the mycorrhizal habit has proved the existence of mutualistic relations of fundamental importance in the economy of the vascular hosts, and older theories respecting the nutrition of mycotrophic plants must be reviewed and tested in the light of modern experimental methods. In the case of *Citrus*, carefully devised experiments and comparative observations on roots of trees subjected to different kinds of manuring in orchard plots should provide evidence of the correctness or otherwise of the hypothesis outlined above.

In view of the heavy cost of manuring in Californian orchards and the inconsistent responses shown by the trees, it is clearly of importance to ascertain whether different treatments and results can be related directly and invariably with the condition of the roots in respect to fungus infection.

M. C. RAYNER.

The Citrus Experiment Station,
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Riverside, California.

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[1] Peyronel, B., *Rev. Biologia*, 5, 6, 3; 1924.

[2] O'Brien, D. G. and M'Naughton, E. J., *West of Scotland Agric. College Research Bull.* No. 1, 1928.

[3] Ciferri, R., *Phytopath.*, 18, 249–261; 1928.

[4] Peyronel, B., *Bull. mens. inform. e not. della R. Staz. Pat. Veg.*, Roma, 3, 43–50; 1922.

[5] Coville, F. V. "The Lychee (Litchi chinensis), a Mycorrhizal Plant." From Groff, G. W. "The Lychee and Lungan", New York, 1921, pp. 151–152.

[6] Peyronel, B., loc. cit. (4).

Number of Mendelian Factors in Quantitative Inheritance

IN a note in the current *Eugenics Review* entitled "Evolution by Selection", "Student" has directed attention to some statistical consequences of the inheritance of quantitative characters, in relation to the theory that these are due to the cumulative effect of a number of ordinary Mendelian factors.

"Student" refers in particular to the remarkable selection experiment carried out by F. L. Winter[1], in which a commercial variety of maize was exposed to mass selection from year to year in two diverging lines for high and low protein, and in two more for high and low oil content. For protein the initial value was about 11 per cent with a standard deviation of a little more than 1 per cent, but in the average of the last three years the mean of the high selection line is 16·82 per cent while that of the low selection line is less than half that value, namely, 7·53 per cent. The aggregate change produced by selection in both directions is thus 9·39 per cent, or more than nine times the original standard deviation.

With respect to variability, it may be noted that the high line now varies from 13·4 to 19·8 per cent, while the extremes for the low line are 5·7 and 10·5 per cent; so that the two lines are now separated by a considerable gap, and therefore cannot possibly have any single genotype in common. The variability of the low selection line has shown a slight tendency to diminish, and that of the high selection line a slightly greater tendency to increase, so that no general tendency to a decrease in variability ascribable to selection is to be observed; thus, there is no reason to think that the selective potentialities of the material have been appreciably exhausted in producing the great modification which has been brought about.

"Student" contrasts these well-substantiated facts with the belief, widely held among geneticists not so many years ago, that the selection of small differences (fluctuations) can only lead to unimportant evolutionary effects. They may also be contrasted with the oft-repeated statement that selection can do no more than select the best of the existing variety of genotypes, and with the commonly taught belief that the diversity available for selection is easily exhausted, from which it is inferred that evolutionary progress must wait upon the occurrence of mutations. It was, indeed, often represented as consisting in these occurrences.

The results obtained with oil-content have been even more striking; for the high oil line now contains nearly six times as much as the line selected for low oil content, and differs from it by more than twenty times the original standard deviation. "Student" uses these data, together with reasonable estimates of the intensity of selection, to obtain an estimate of the least possible number of factors which must be postulated to obtain the results up to the date of the report; he concludes that at least 100–300 factors would be needed; and, taking into account the complete lack of evidence that selection is nearing its limit, considers that it is more probable that the actual number of factors is measured in thousands.

Estimates of the number of factors needed to explain quantitative inheritance are beset with considerable difficulty, and "Student" has admitted to me in correspondence that his calculation fails from over-simplification. Other well-established phenomena in maize, however, such as the flood of recessive defects revealed by every plant which has been used to found a selfed line, combined with the inevitable rarity of each of these defects, taken individually, in the population from which the foundation plant was selected, force one to the conclusion that all commercial varieties must be segregating in hundreds, and quite possibly in thousands of factors influencing the normal development of the plant. This emphatic experience, has, I believe, killed among maize breeders all those doctrines concerning the supposed inefficacy of the selection of minute differences, with which the teaching of modern genetics was at first encumbered.

It should be emphasised that the result of importance for evolutionary theory is not that the number of factors must be very large, thousands for example, rather than hundreds, but the direct demonstration that selection has the exact effects that selectionists have ascribed to it, without the limitations by which its action has been supposed to be restricted, on the strength of an early misapprehension as to the number and variety of the Mendelian factors exposed to its cumulative action.

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Feb. 15.

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[1] *J. Agric. Res.*, **39**, 461–476; 1929.

Fourier Analysis and Vowel Curves

IN NATURE of December 24, p. 965, Prof. E. W. Scripture discussed difficulties in applying Fourier analysis to recorded vowel curves, and he published two illustrations of the latter. The second of these, or at least what the corresponding curve would have been if the process of ground noise suppression had not been used in the recording, is strikingly similar to a curve I once drew up to illustrate complex modulation of a carrier wave in radio. The 'interior waves' correspond to the carrier wave, and the regular repetition or pattern corresponds to the so-called 'modulation envelope'.

This suggests that an alternative method of analysis, the applicability of which to a vowel curve similar to that published might repay investigation, would be to consider the vowel curve as that of a 'carrier note' undergoing modulation, the modulation being not necessarily sinusoidal but perhaps more complex. For example, the 'modulation envelope' of the published curve approximates to a saw-tooth form.

This method of analysis might not really be an alternative to Prof. Scripture's method, and might only be an alternative method of stating the latter. An artificial 'vowel curve' corresponding to saw-tooth modulation or other arbitrary modulation would make an interesting test of Prof. Scripture's and of other methods of analysis. Incidentally, such an artificial vowel curve could fairly easily be recorded and reproduced, and the electrical equivalent of it could be generated and reproduced directly without recording.

It may be worth while considering the bearing on these considerations of the fact that a modulated wave may be analysed into a carrier *plus* side-bands. A wave form approximating to a 'saw-tooth' modulated carrier can be constructed out of the carrier and a small number of side bands, all undamped waves. The general appearance of such a wave form would be similar to that of the vowel curve published, and therefore would afford (though in this case erroneously) just as strong grounds for holding that the wave form was inconsistent with analysis into undamped waves and that it required an analysis into damped waves.

The point which emerges from this is that Fourier analysis is not the only analysis into sinusoidal components. Consider a sinusoidally modulated carrier represented by $A(1+k\sin\overline{pt+\alpha})\sin\omega t$. If the carrier frequency, $\omega/2\pi$, is much greater than the modulation frequency, $p/2\pi$, the resulting wave form *seems* to be periodic at frequency $p/2\pi$, because the modulation envelope is periodic at this frequency. Close examination of the curve, or mathematical examination of the formula, shows, however, that the carrier waves in one cycle of the modulation frequency are situated differently with respect to the modulation envelope from those in another cycle, there being a phase difference. Unless ω is a multiple of p, the wave is not periodic at frequency p, and unless ω and p are commensurate there is no true period at all. Fourier's analysis is therefore not applicable, but this does not prove definitely that analysis into sinusoidal components is not possible.

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Jan. 27.

Photography of Faint Transient Light-Spots

PROF. H. HARTRIDGE in his letter in NATURE of January 21, expresses the need for "A lens having a numerical aperture of 0·8 or 0·7, a focal length of 25–50 mm. and adequate definition on the film over an area of 3–5 mm." It is perhaps not commonly noticed that a Mangin lens-mirror out of a motor-car headlight has just about this specification. I have used such a mirror to photograph a cathode ray oscillogram. The definition, though not what one would desire, was yet good enough to be useful.

Apparently there is no other commercial type of optical system that has both the large numerical aperture and the long focal length required, together with passable definition; but I should be glad to be corrected. The tiny image of an achromatic substage condenser was spoilt by scattering in the emulsion.

Some Mangin mirrors are purposely made with considerable spherical aberration on the axis, of a type thoroughly described by A. C. W. Aldis[1]. This aberration can, I find, be very simply corrected by placing a block of glass, having plane parallel faces, so that the rays converging from the mirror traverse the block and form the image on its outer surface. The principle is the same as that of the correction of the aberration of a microscope objective by using a coverslip of the correct thickness. But the thickness required is very much greater. By piling up plates, I find that 4·8 cm. of crown glass, $\mu_D = 1{\cdot}51$, is just right for an old naval mirror marked "5·25 ins. optical focus". The block does not make the coma worse, and only slightly increases the colour aberration. In a photograph taken with this system working at a numerical aperture of 0·5, point-objects appear as disks 1 mm. in diameter. This holds over an area of about 1·5 cm. diameter on the photograph. The merit of this arrangement of a mirror and block is its cheapness. Better, but presumably costly, lenses for photographing faint objects have been described by Rayton[2], also by McLennan and Ireton[3].

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Technical College,
Paisley.
Feb. 25.

[1] A. C. W. Aldis, *Trans. Optical Soc.*, **21**, 113; 1920.
[2] W. B. Rayton, *Sci. Abs.*, A 3987; 1930.
[3] J. C. McLennan and H. J. C. Ireton, *Proc. Roy. Soc.*, A, **129**, 31; 1930.

Constitution of Vitamin C

IN a recent communication[1] Micheel and Kraft have proposed a structure for ascorbic acid of a furane-carboxylic acid type. This structure was considered by us some months ago, and although attractive as explaining many of the chemical properties, we did not put it forward, principally on the ground that it would not satisfy the crystallographic requirements; these are, briefly[2], that the pseudo-symmetry, optical properties and the thinness of the molecule demand a structure which is almost completely flat. Unless the disposition of the carbon valencies in ascorbic acid is entirely novel, a molecule of the structure proposed by Micheel and Kraft would certainly not meet these requirements. These objections, which were considered in detail by us before the publication of our previous note[3], still hold, and they apply also to variants of Micheel and Kraft's structure containing ethylene oxide or pyranose rings.

E. G. COX.
E. L. HIRST.

Chemistry Department,
The University, Birmingham.
March 3.

[1] NATURE, **131**, 274, Feb. 25, 1933.
[2] NATURE, **130**, 205, Aug. 6, 1932.
[3] NATURE, **130**, 888, Dec. 10, 1932.

Substituted βγ-Diphenyladipic Acids and Derivatives of Chrysene

PROF. R. ROBINSON and Mr. G. R. Ramage in a recent letter[1] state that they are engaged in the synthesis of certain substituted βγ-diphenyladipic acids and of certain derivatives of chrysene. I have been working in this field for some years and work in progress, or projected, in part in collaboration with research students, includes the synthesis of substituted βγ-diphenyladipic acids derived from *o*-, *m*-, and *p*- chloro-, bromo-, iodo-, hydroxy-, methoxy-, nitro-, amino- and dimethylamino- benzaldehyde and from veratrole and piperonal via the benzylidene malonic esters[2] and cinnamic esters[3] with the object of (*a*) effecting the optical resolution of both forms, (*b*) their conversion into derivatives of chrysene[4], and (*c*) their conversion into derivatives of possible therapeutic and industrial value. The research on the reduction of substituted cinnamic esters has been assisted by grants from the Chemical Society in June 1930 and 1931.

A. I. VOGEL.

Woolwich Polytechnic, S.E.18.
Feb. 18.

[1] NATURE, **131**, 205, Feb. 11, 1933.
[2] Vogel, *J. Chem. Soc.*, 1014; 1928.
[3] Oommen and Vogel, *J. Chem. Soc.*, 2148; 1930; Oommen, Ph.D. Thesis, London, 1929; compare Henle, *Annalen*, **348**, 16; 1906.
[4] Compare von Braun and Irmisch, *Berichte*, **64**, 2461; 1931.

Wave Equations and the Conservation of Energy

IN Dirac's "Quantum Mechanics" the "equation of motion" satisfied by any observable ξ not involving the time explicitly is

$$(i\,h/2\pi)\,\dot{\xi} = \xi H - H \xi$$

where H is the Hamiltonian. The conservation of energy, when H does not involve the time explicitly, is deduced from this by putting $\xi = H$, giving $\dot{H} = 0$.

Another fundamental assumption of Dirac's theory is his form of wave equation, which imposes another condition on H. He points out that it is legitimate to assume the quantum conditions only for one particular time and then investigate whether they hold for all time, but a similar limitation, which appears to hold for the wave equation, seems to have been overlooked. The condition that the wave equation may hold for all time leads to an equation which expresses the conservation of energy. We thus have two conditions that it seems desirable a wave equation should satisfy, leading to the conservation of energy and charge.

It is known that the second condition is satisfied by Dirac's linear equation and also by Schrödinger's non-relativistic equation, but not by the second-order relativistic equation. I have proved (in the course of work not yet published) that the first condition also is satisfied in the same two cases. These facts seem to provide a stronger reason for rejecting the second-order relativistic equation than those usually given.

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Jan. 26.

Band Spectra of Barium Oxide (BaO)

IN the flame of the arc between carbon electrodes containing barium chloride or nitrate, a class of red-degrading bands appear between λ 4300 – λ 8000. These have been attributed to the oxide of barium and analysed into two systems with their (0,0) bands at 17,713 ν and 16,060 ν respectively. The rotational structure analysis of (0,1), (0,2) and (1,1) bands for the less refrangible system and (1,0), (0,0), (0,1) bands for the more refrangible system have been done. The two systems have a common lower level, and are due to $^1\Sigma$, $^1\Sigma$ transitions. In the lower state, $B'' = 0{\cdot}3075$ cm.$^{-1}$. The detailed account of the analysis will appear elsewhere.

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Research Items

Heathen Baptism in Early Britain. A communication from Miss Eleanor Hull in *Folklore* (vol. 43, pt. 4) brings together evidence from various sources bearing on the existence of baptism as a pre-Christian rite in Britain. The fact that it is found in Wales, where Scandinavian influence was small, seems to point to the fact that it had an independent origin in these islands and was not introduced by Norse or Danes. Among the Scandinavian races, pre-Christian baptism, as the sprinkling of the child with water which accompanied the bestowal of a name, was an integral part of the Asa creed. It established a bond between baptiser and baptised, sometimes constituting the latter the heir of the former. The Norse practised lay baptism without religious ceremony; but in Ireland a regular rite, at which Druids officiated, was carried out. Aillil Olum, who succeeded to the throne of Munster early in the third century, was baptised by the Druid who foretold the marriage of his father Eoghan and by his prognostication fixed the propitious day of the marriage. The 'heathen baptism' is also mentioned in the Irish version of "The Travels of Sir John Mandeville" in connexion with the circumcision of Isaac and Ishmael. The tales of the Mabinogion give several instances of heathen baptism, as for example in "Pwyll, Prince of Dyved" and in "Math, Son of Mathonwy". Scottish folk-tales give fewer examples; but in the story of "The Knight of the Red Shield" the knight, it is prophesied, shall be unbaptised "until he shall come to an island and strike a crag of stone on a man". In the Fenian tales baptism is taken as a matter of course by the heroes; and it is considered by Dr. J. A. MacCulloch that the Scottish custom of dropping three drops of water on the forehead of a child immediately after birth is a relic of the rite of pagan baptism.

Ancestor Spirits among the Nuba. Mr. D. Hawksworth, in recording some observations among the Nuba of Southern Kordofan (*Sudan Notes and Records*, vol. 15, pt. 2), deals with the cult of ancestral spirits and its relation to the spiritual and secular headship of the social group. The veneration, almost amounting to worship, of the ancestral spirit is the basis of their religion, their exceptional tribal patriotism, their reluctance to leave the home of their ancestors, their reverence for the elders, and so forth. All communications are addressed, not to God, but to the ancestral spirit, and from it come all punishments for sin. Communications to the ancestral spirit are made through the *kujurs*, tribal priests, the mediums of the ancestral spirits, who seize upon them on occasion and throw them into a trance. The office of *kujur* is not hereditary, as the spirit may seize upon anyone; but as a rule, especially in a family group, the ancestral spirit seizes one of the offspring of the deceased *kujur*. *Kujurs* fall into two categories: the great *kujurs* who are seized by the spirit of the original ancestor of the tribe, and the lesser *kujurs* of the family group, who generally specialises in some branch of culture. The great *kujurs*, except in certain tribes which have kings, are the patriarchal heads of the tribe, exercising both spiritual and secular powers. They are entitled to the slaves and booty taken in war, they receive the bride-price of female orphans, and when a male orphan has no family head, they pay the bride-price on his behalf. The *kujur* makes the necessary communications and offerings at stated times to the ancestral spirit, and receives tribute on his behalf. The office is not confined to males; but when a female *kujur* is appointed, her husband immediately runs away.

Stork in Western Europe. Press notices on the Continent frequently state that the white stork (*Ciconia ciconia*) is becoming scarce in western Europe and that its final disappearance is probable. But the stork has never been very common in western Europe, where, as a bird of Asiatic origin, it is at the limit of its range. Nevertheless, according to Jan Sokolowski, the progress of civilisation, particularly as shown in the draining of marshes, has made more difficult the life, and still more difficult the multiplication of storks, so that in some districts of Germany their numbers have been reduced by as much as 60 per cent. The protection of the stork now in force throughout Germany had become necessary, and that it has been efficient is evident from the latest reports, which state that the number of nests in Eastern Prussia has risen to 9,200. In Poland, east of the Vistula, storks are more numerous than in western Europe and the appearance of birds in greater numbers of nesting pairs makes it certain that there the stork is in no danger of extermination (*Ochrona Przyrody*, Warszawa, 12, p. 1, 1932).

Fauna of Hot Springs in North America. In the summers of 1923, 1927 and 1930, Charles T. Briers visited hot springs in the Yellowstone National Park, and in the adjoining States of Utah, New Mexico, Nevada, California and Idaho for the study of their fauna. The present paper is his third on the subject (*Proc. Amer. Acad. Arts Sci.*, 67, No. 7, 1932). In such thermal springs special limiting factors are associated with the abnormally high temperature of the water, the highly variable hydrogen ion concentration, and the variable salinity, which is comparable to that of brackish water. The adaptation to high temperature extends over a narrow range of 5°–20° C., as the animals live at temperatures of 40°–60° C. instead of at 30°–40° C., which is the upper limit of existence for the majority of terrestrial and aquatic animals alike, including pœcilothermic and homœothermic types. As to how the peculiar adaptations of the hot springs' fauna arose, the author is uncertain: perhaps naturally resistant forms were selected, perhaps the constitution of the species has changed towards greater heat-resistance, perhaps the simpler forms are relics of a primordial fauna which has always lived at high temperatures, but the last case is not very likely.

Chromosome Numbers in Vertebrates. Attention may be directed to a useful list of chromosome numbers in vertebrates, compiled by Messrs. K. Oguma and S. Kakino (*J. Genetics*, vol. 26, No. 2). Many of the earlier counts in birds and mammals were clearly much too low, due to clumping and inadequate fixation of the chromosomes. Twelve appears to be a common haploid number both in fishes and amphibians, 11 also being found in certain fishes and toads. Several recent papers conclude that in reptiles, as in birds, the male is XX as regards its sex chromosomes, the female being the heterozygous sex. In general, the chromosome numbers in reptiles are higher than in amphibia, where 12 is the commonest number. Disregarding the earlier and inaccurate counts, the numbers in birds are high in the few species in which a critical study has been made, for example, 38 in the duck, turkey and fowl. Among mammals the numbers are relatively low in marsupials ($n = 6$ to 11), although some of these numbers may require revision upwards. In other mammals they appear to range so high as $n = 43$. As regards man, the $2n$ number 48 and the presence of an XY pair in the male has recently been confirmed by Minouchi and Ohta.

Temperature and Seed Germination. A review by Thos. I. Edwards of great interest to seed-testing laboratories has recently appeared (*Quart. Rev. Biol.*, 7, No. 4, 428–443, 1932) entitled "Temperature Relations of Seed Germination". The conception of the term 'optimum temperature for germination' is shown to be capable of several interpretations, which are discussed in the paper. The minimum and maximum temperatures for germination are also investigated. Many instances where seeds of wheat and other plants have started to grow on ice are given. The highest temperature of germination seems to be that of *Pinus rigida* at 57° C. The paper contains much interesting information about the behaviour of various seeds at different temperatures, but its main result is apparently a vindication of the generally accepted standards of temperature at present employed by seed-testing stations.

Ultra-Violet Light and Fungi. The effect of ultraviolet light on various species of *Fusarium* has recently been studied in detail by Alice A. Bailey (*Bot. Gaz.*, 94, 225–271, 1932). Rays from a quartz mercury vapour lamp were directed on to agar cultures through suitable ultra-violet transmitting screens which were used as the lids of the respective culture dishes. Irradiation always slowed up the radial growth of a culture as compared with a control in ordinary light, and often the growth appeared zoned or had other physical differences. The colour of *Fusarium* colonies was often altered as a result of the influence of ultraviolet rays. The most pronounced effect was in the substitution of microspore for macrospore formation in many species. Exposure to the treatment was made for periods of 15 minutes on each of three successive days, and the culture was placed at a distance of 40 cm. from the lamp. The absence of a filter produced very deleterious effects upon fungus cultures.

Carboniferous Molluscs of the Donetz Basin. The first monograph of Carboniferous pelecypod molluscs found in the Donetz basin in south Russia, just published by D. M. Fedotov (Trans. Geol. Prospecting Service, U.S.S.R., fas. 103) includes detailed critical descriptions and good plates of 120 species. An interesting result of the work is that only 21 out of 120 species have been previously known from the Carboniferous of Western Europe, and a few are Russian species, while the bulk of the Donetz species proved to be either identical with, or closely related to, North American species. The species common to the Donetz basin and North America belong mainly to the Upper and Middle Carboniferous, which correspond to the strata known as Pennsylvanian in America.

Age of Meteor Crater. It is reported by Science Service that recent investigations by Prof. Eliot Blackwelder indicate that Meteor Crater, the great pit in northern Arizona that is believed to mark the impact of a flight of meteorites, is probably very much older than has generally been assumed. Past estimates have ranged from two to ten thousand years, but it is now suggested that the crater was made during the last interglacial epoch, perhaps 40,000–75,000 years ago. The evidence includes indications of a former moist climate that was of relatively long duration. At the bottom of the crater there is a deep deposit of finely pulverised quartz with many remains of diatoms and snails, interbedded with freshwater limestone, coaly material, and a single layer of volcanic ash that records an explosive eruption somewhere in the neighbourhood. The lake beds indicate a long-standing body of water, and not a succession of *playas* or seasonal ponds. At present, permanent water is not struck within 200 feet of the bottom of the pit. Other lines of evidence based on the erosive work of wind and water support the conclusions reached.

Ionisation in Electric Cables. The almost universal use of high electric pressure for the transmission of power to long distances has made it a problem of great commercial importance to increase the electric strength of the insulating wrappings round the cables so that they may be able to withstand for many years the high electric stresses to which they are continuously subjected. In a paper on "Ionization in Cable Dielectrics" read to the Institution of Electrical Engineers on March 9, P. Dunsheath discussed the rapid developments that have recently taken place in the manufacture of these dielectrics. Since its inception a few years ago, the oil-filled cable has given an excellent record of performance and this has perhaps diverted attention from the many thousands of miles of 'solid-type' cable which have been giving very satisfactory service at voltages up to 66,000 in all parts of the world. At 33,000 volts, trouble due to inherent dielectric failures is now almost unknown. The breakdown of cables is generally due to vacuous spaces called 'voids' in the dielectric. The electrical breakdown of the rarefied gas in a cable void is controlled by laws which so far are not completely established. When electrical stress is applied to gas in an enclosed space it first of all speeds up the movement of the relatively few ions present, without causing any of the usual visual or chemical effects of a discharge. When the ions are further accelerated, a stage is reached at which the ions split up neutral molecules by collision and the current through the gas rapidly increases. At this stage the effect is cumulative and a state of ionisation is attained. With our present knowledge, however, we cannot foretell the stress at which the breakdown occurs with any degree of precision. The author concludes that in high-voltage cable dielectrics the most important phenomenon is ionisation. This makes itself evident by increasing the total electric loss at a rate greater than the square of the applied voltage.

Photochemical Decomposition of Diazomethane. Kirkbride and Norrish (*J. Chem. Soc.*, Feb.) find that diazomethane, CH_2N_2, shows two regions of absorption, the first in the blue and violet, with a structure suggesting predissociation, and the second, very intense and continuous, in the ultra-violet beyond 2650 A. The primary photochemical process is an interesting one, since it appears to involve a simultaneous severance of both nitrogen atoms from the molecule. The subsequent history of the CH_2 radical, leading mainly to ethylene and propylene, but also to other by-products, can be fairly satisfactorily traced. The quantum efficiency is 4–5 for light of wave-lengths 436 and 365 mμ. In no instance could an explosion (which is readily initiated thermally) be brought about by the action of light. There is thus no evidence for a reaction chain of any appreciable length, which is somewhat surprising in view of the strongly exothermic character of the decomposition. The primary process is most probably: $CH_2N_2 + h\nu = CH_2 + N_2$. The close resemblance between the absorption spectra of azomethane and diazomethane indicates that the azo-group is present in the latter, and supports the ring formula for diazomethane. When the reaction was carried out in presence of hydrogen, methane was produced in quantity, no doubt by interaction of CH_2 groups and hydrogen, and there was a corresponding suppression of secondary reactions.

International Atomic Weights. The Table of International Atomic Weights published in the February *Journal of the American Chemical Society* contains two alterations, namely, iodine = 126·92 (in place of 126·93) and lanthanum = 138·92 (in place of 138·90). The accompanying report directs attention to the prevailing uncertainty in the factor for the conversion of values from the physical to the chemical scale. Two values are in use, namely, 1·00022 and 1·00012, the first being supported by Aston's data for the intensities of the lines O^{16} O^{17} and O^{16} O^{18} for comparison with O^{16}_2. "Since the accuracy of the mass-spectrograph is admittedly no greater than 1/10,000 and the uncertainty of the conversion factor obviously is as large, while the measurement of isotopic ratios has inherent uncertainties, the degree of precision of the determination of atomic weights from mass spectrograph data still seems inferior to that of the best chemical methods, although the striking concordance of the two methods in most cases is reassuring". The case of the isotope of hydrogen, H^2, is mentioned. The mass is found by Bainbridge to be 2·01353, assuming He = 4·00216 and H^1 = 1·00778. The atomic weight of hydrogen, with a proportion of H^2 approximately 1 in 4,000 as found from the spectrum of ordinary hydrogen, is therefore slightly higher than the value of H^1 found by Aston. The discovery of additional isotopes of tellurium and their percentages has given (with the packing fraction -5×10^{-4} and conversion factor 1·00022) an atomic weight 127·58, in much closer agreement with the chemical value (127·5) than Aston's 128·03. It may be added that the value for the atomic weight found by Baker and Bennett in 1907 was 127·60, and although 127·5 is adopted in the actual International Table, most recent chemical values are nearer 127·6 than 127·5.

Astronomical Topics

Origin of the Planetary System. A new theory of the origin of the system is proposed by Dr. R. Gunn (*J. Franklin Inst.*, June 1932). Instead of the appulse of two stars, he postulates the fission of a single star by rotational instability. He supposes that the star originally rotated in a few hours, but that after fission the strong tidal action between the components slowed it down. While the two bodies were within Roche's limit, a certain amount of disintegration took place, which is supposed to have given rise to the planets. When the star split, one side of each component had been near the centre of the star when single, and was much hotter than the other side. The reaction of the intense radiation pressure from the hotter sides made the stars separate, and the other component is supposed to have receded to a stellar distance.

The author concludes that Mars must have originally had a large satellite, to increase the time of its rotation from a few hours (less than the 7½ hours which Phobos takes to go round) to its present value. He conjectures that this large satellite escaped, and may have split up to form the asteroid family. The author was led to his theory by the consideration that the close appulse of two stars is acknowledged to be extremely rare, while the prevalence of binary systems makes one suppose that the fission of a star happens frequently. Many of the details are speculative, but it is well in a problem of such difficulty to explore every possible avenue.

Hornsby's Observations of Mercury. Dr. J. Jackson took a large part in the new reduction of the observations made by Dr. Hornsby at the Radcliffe Observatory, Oxford, during the last quarter of the eighteenth century, and the observations of Mercury have recently been discussed (*Mon. Not. Roy. Astro. Soc.*, December). The question of the phase correction is a troublesome one, as it appears that Hornsby tried to observe the true centre; solutions have been made with and without corrections. Tabular places for the sun and Mercury were computed from Newcomb's tables to compare with the observations.

The most interesting point is the motion of the perihelion of Mercury; after reducing from Newcomb's precessions to those of de Sitter, Jackson finds that the excess of the motion over the Newtonian value is 43·1″ per century, with a probable error of 1″. The value deduced from Einstein's theory is 42·9″, a satisfactory agreement.

Rather a large correction is found to Newcomb's obliquity of the ecliptic, namely, 0·53″; it is pointed out in the paper that the evidence from other planets also points to a positive correction though somewhat smaller.

There are 349 observations of Mercury in the years 1774–1798; their reduction adds very considerably to our knowledge of the elements of this planet, and their secular variations.

Annuario del Observatorio Astronomico de Madrid, 1933. This useful almanac and handbook contains particulars of the various calendars in use in the world, extensive extracts from the nautical almanacs, monthly star-maps for the latitude of Madrid, and various geographical and physical tables. The comet table needs bringing up to date; it claims to give all comets that have been observed on their return but omits (*inter alia*) Grigg-Skjellerup, Neujmin I, and Pons-Coggia-Winnecke-Forbes. Also it gives Perrine's comet as observed in 1922, though this identity is highly improbable. On page 122 the mean annual motion of Pluto is given as 1° 45′; it should be 1·45°.

Work of the Forestry Commission[*]

THE 'forest year' of the Forestry Commission ends on September 30, and that date in 1931 brought to a close the twelfth year of its work. It was inevitable that operations and a policy that are dependent upon Government grants and a present non-productive expenditure should have been subject to a close scrutiny from the May Committee on National Expenditure.

For the second decade of the Commission's work, it had been estimated that the gross cost of the whole business (purchase of land, planting, etc.) and the ancillary operations such as assistance to private forestry, education, research, etc., would amount to £11,275,000 for the decade; working receipts were estimated at £2,160,000 and the net contribution from the Exchequer was expected to be £9,115,000. The chief objectives laid down during the second decade were to plant 353,000 acres and to establish 3,000 worker's holdings. The planting programme was to be on an expanding scale, beginning with 25,000 acres in 1929 and rising to 44,000 acres in 1938, while the holdings programme was to be at the rate of 350 holdings yearly for the first five years, and 250 holdings yearly for the second five years. In order to carry out these programmes, it would be necessary to acquire each year 6,000 acres of plantable land and 2,500 acres of agricultural land.

It has been already stated in NATURE (Sept. 17, 1932, p. 427) in a note discussing a paper by Sir John Stirling-Maxwell on "Forestry and National Economy" that the sum sanctioned for the above proposals received a severe cut at the hands of the May Committee, the majority report making the following recommendation: "After weighing up all these considerations we recommend that no fresh acquisitions of land be made for the present and that no more forest worker's holdings be created, but that afforestation proceed at the rate of 20,000 acres per annum for five years on the land already acquired. This course is estimated to save £478,000 next year and £560,000 per annum in subsequent years as compared with the present policy."

In subsequent discussions with the Government, the Commissioners stated that it was desirable to maintain the main elements of forest policy, which were, briefly, the continuance of planting and of the acquisition of plantable land, and the provision of sufficient houses and holdings to work the forests economically. After due consideration, the Chancellor of the Exchequer undertook that the Government would provide annually for the next five years the sum of £450,000 which, with working receipts, would enable the Commissioners to spend rather less than £600,000 a year on forestry operations.

With this sum at their disposal, the Commissioners anticipate that they will be able to carry out the following work: (1) Maintain a planting programme of 20,000 acres a year. (2) Acquire sufficient plantable land to keep intact the reserve of land which is required for maintaining the planting programme. (3) Provide sufficient forest worker's holdings (numbering perhaps 15–20 a year) for working the forests efficiently, and also repair and maintain such holdings as are necessary for the utilisation of the non-plantable land. (4) Provide grants for planting on the same scale as during the last three years. (5) Maintain intact their research activities and make suitable provision for forestry education and other ancillary activities.

The question of forestry on private estates has been receiving the attention of the Commissioners, and the Consultative Forestry Committees of England, Scotland and Wales were consulted and a joint report presented. This report stated that private forestry is not receiving the same attention as in pre-War days, in spite of the spread of technical knowledge and State encouragement. The causes for the decline during post-War years are admitted and well known to all. In the urgent need for national economy the joint report was unable to suggest any general solution. The Commissioners appear to be of opinion that the State, in the long run, might have to relieve the private owner of his responsibility in maintaining the woodlands of Great Britain.

Apart from the question as to whether this is a correct policy, either for the State or the tax-payer, it is open to doubt whether it is even a truly economic one. In France the State forests form about a third only of the total forest area, in Sweden 20 per cent and in Germany 25 per cent. With a reduction of taxation in Great Britain, with the available technical knowledge and the advantage of the presence in the country of the Forestry Commission, it may be hoped that the land owner will find it possible to follow in the footsteps of his confrères on the Continent. The disappearance of the private forest owner was evidently not contemplated by Lord Clinton, during his tenure of the chairmanship of the Commission. In an address delivered at the annual meeting in 1928 of the Royal Scottish Arboricultural Society (see NATURE of May 5, 1928, p. 697) Lord Clinton said: "I am not at all confident that the State can properly undertake the full duties of afforestation. I think the keenness of the general public, who in theory are very keen on forestry, is likely to evaporate directly they begin to understand the great cost which will fall on them if the State shoulders the whole burden."

Soon after the close of the year under review, the chairman of the Commission, Sir John Stirling-Maxwell, resigned. Of his work for Great Britain in the cause of forestry and that of his two predecessors, Lord Lovat and Lord Clinton, it is impossible to speak too highly. Sir Roy Robinson, a technically trained forester, now assumes the chairmanship. In spite of the fears of some well qualified to speak when the Forestry Bill was passed in 1919, there is little doubt that the new Forestry Department was only able to weather the stormy times of its first twelve years owing to its fortunes being in the hands of three such able and powerful land owners as the past triumvirate of chairmen.

The Report deals in general with the work of the year ending September 1931. The net total area of land acquired in Great Britain to this date was 627,075 acres, of which 393,448 acres were classified as plantable, 58 per cent being in England and Wales and 42 per cent in Scotland. The area planted during the year was 25,630 acres, the total area planted during the twelve years being 188,985 acres, of which 177,456 acres consisted of conifers and 11,529 acres of hardwoods.

An interesting item in the Report is the valuation by the Inland Revenue authorities of the Crown properties transferred from the Office of Woods to the Forestry Commission. The chief of these were the New Forest and the Forest of Dean, the total valuation of which amounts to £1,227,495.

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[*] Forestry Commission. Twelfth Annual Report of the Forestry Commissioners for the Year ending Sept. 30, 1931. Pp. 43. (London: H.M. Stationery Office.) 9*d*. net.

Under education and research the Report summarises the conclusions of the Irvine Committee on the training of candidates for Government forest services. The Commissioners pass no comment upon these conclusions which, it is understood, are receiving the careful consideration of the universities concerned.

Harvey and Preventive Medicine

A BRIEF account of Sir George Newman's Harveian Oration to the Royal College of Physicians of London appeared in NATURE shortly after its delivery (NATURE, Oct. 29, p. 657). The full text of the discourse has since been published in pamphlet form.*

In his discussion of the new physiology which was inaugurated by Harvey's demonstration of the mechanism of the circulation of the blood, Sir George Newman points out that in 1622, six years after Harvey's first Lumleian discourse and six before his book was published, the demonstration of the lacteals and lymphatic system by which nutriment reached the blood was made by Aselli, Pecquet and Rudbeck. In 1648 the chemistry of digestion and the blood was investigated by van Helmont. Ten years later, the corpuscles of the blood were discovered by Swammerdam and Malpighi, and in 1661 Malpighi revealed the existence of the capillaries, which had been suspected by Harvey who, in the absence of a microscope, had been unable to detect them. In 1669 the contributions to the physiology of respiration by Boyle, Hooke, Mayow and Richard Lower demonstrated the purpose and process of aeration of the blood in the lungs, its selective use of the oxygen in the air, its conveyance to the tissues by the blood, and the resulting vitality and functioning of the tissues.

In the succeeding century, the actual gases which control life—carbonic acid, nitrogen and oxygen—were separated and fresh knowledge of the nervous and digestive systems was acquired. In the middle of the nineteenth century the foundations of endocrinology were established by the work of Thomas Addison, Claude Bernard and Brown-Séquard, and since then the progress of physiology in Great Britain has been pre-eminent in quantity, quality and scope.

Sir George Newman next considers the application of these discoveries to preventive medicine. He points out that from the sixteenth century onwards, the research worker has collaborated with the private practitioner and the public medical officer in the prolongation of life and the prevention of disease. Striking examples of this statement are furnished in the eighteenth century by Lind and Sir Gilbert Blane in their defence of the health and the dietary of seamen, by William Cadogan, the pioneer in maternal and child welfare, and Sir John Pringle, who reformed the health of the Army. In recent times the labours of modern physiologists have contributed not only to the conservation of health but also to the prevention and cure of disease, as is exemplified by their work in connexion with cretinism, goitre, diabetes, anæmia, malnutrition, deficiency diseases, beri-beri, osteomalacia, scurvy and rickets.

The study of the cause and control of infective diseases is taken by Sir George Newman as another example of the Harveian method and spirit. The conveyance of infection by the circulating blood was acknowledged by Harvey's contemporaries, such as Glisson and Sydenham in the seventeenth century, and by the eighteenth century physicians who explored the circumstances and clinical features of infective diseases and observed their relation to external environment, to seasons and to meteorological conditions. Examples of such men were Huxham, who investigated typhoid, typhus, Devonshire colic, scurvy and scarlet fever; Heberden, who studied chicken-pox, measles and epidemic colds; Fothergill, who described epidemic sore throat; Haygarth, well known for his work on small-pox and typhus; Edward Jenner, who introduced vaccination, and Willan, the father of British dermatology. It is noteworthy that in spite of the absence of any exact knowledge of the causation of disease, which was not reached until the advent of bacteriology in the later half of the nineteenth century, two significant conquests were achieved by the English before the end of the eighteenth century in the control of scurvy and of small-pox.

The production of artificial immunity, which Sir George Newman rightly regards as the greatest single advance in preventive medicine, is chosen by him as yet another example of the application of the Harveian method. Although the protective qualities of the blood were known to Harvey, it is only within comparatively recent times that an explanation of this property has been found, thanks to the work of Pasteur, Lister, Metchnikoff and Sir Almroth Wright.

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* "The Debt of Preventive Medicine to Harvey and the College of Physicians." (Harveian Oration, 1932: The Royal College of Physicians of London.) By Sir George Newman. Pp. 47. (The British Periodicals Ltd., 19 Cursitor Street, E.C.4.) 1s. net.

Spreading of Liquids on Solid Surfaces

IT is generally supposed that on metals as well as on water the fatty oils and fatty acids should possess a more pronounced spreading tendency than the mineral oils, yet experiments show that this is not the case. Buckley and Snyder (*J. Amer. Chem. Soc.*, Jan.) have confirmed this observation and have discovered an interesting phenomenon of rupture of thin layers of liquid on a solid surface due to the instability created by an underlying adsorbed film of low surface energy. Fatty oils and fatty acids lower the static coefficient of friction between metal surfaces more than do mineral oils of the same viscosity, and a mineral oil containing a small percentage of a fatty acid lowers the friction almost as much as a pure fatty oil. This is in agreement with a preferential adsorption of fatty acid on the metal surface, indicating that these acids lower the surface tensions of metals more than do mineral oils.

Mineral oils which spread rapidly on ordinary metal surfaces seem to have no spreading tendency on a metal surface covered with an invisible fatty acid film. When a drop of petroleum oil containing some fatty acid is placed on a polished plate, the mineral oil spreads in its normal manner, the fatty acid being preferentially adsorbed on the solid and lowering the surface tension until at a minimum thickness of liquid layer, rupture of the film occurs.

Any portion of oil in the midst of an area covered with an adsorbed film pulls itself together into a drop, whilst the oil in contact with clean metal continues to spread outward. It is supposed that fatty oils and fatty acids are prevented from spreading on metal surfaces by the great reduction in the surface energy of the metal which is brought about to some distance in advance of the spreading layer by the breaking away of an expanding ring or by the condensation of vapours.

University and Educational Intelligence

CAMBRIDGE.—Dr. N. J. T. M. Needham, of Gonville and Caius College, has been appointed Sir William Dunn reader in biochemistry in succession to Prof. J. B. S. Haldane.

V. J. Chapman, of Pembroke College, has been elected to the Frank Smart studentship in botany.

The following have been awarded Smith's prizes: E. A. Maxwell, Queens' College, for an essay entitled "The Invariants of Certain Surfaces" and R. H. Stoy, Gonville and Caius College, for an essay entitled "The Planetary Nebulæ". Rayleigh prizes have been awarded to the following for the essays indicated: W. E. Candler, Trinity College, "The Stability of the Rings of Saturn"; C. Strachan, Corpus Christi College, "Reflection by Monomolecular Films"; M. H. H. Walters, King's College, "The Effect of Stellar Encounters on the Orbits of Binary Stars".

EDINBURGH.—The Senatus has resolved that the honorary doctorate in laws be offered to the following: The Right Hon. Craigie Aitchison, Lord Advocate; Sir James Caw, formerly director of the National Galleries of Scotland; Sir Henry Dale, director of the National Institute for Medical Research; Prof. G. H. Hardy, Sadleirian professor of mathematics, Cambridge; Sir Alexander Houston, director of water examination, Metropolitan Water Board; Sir Hugh Rose, chairman of the General Board of Control for Scotland; Mr. J. C. Smith, formerly senior inspector of schools in Scotland; Mr. W. W. Tarn, author of works on the Hellenistic age.

LONDON.—The Armourers and Brasiers' Company and the Carpenters' Company have decided to make grants to the University of £2,000 and £1,000 respectively in the shape of annual payments extending over ten years; and the Ironmongers' Company has granted £500 and the Dyers' Company £105. These benefactions will be applied towards meeting the cost of the new Ceremonial Hall to be erected on the University's site in Bloomsbury.

A munificent bequest by the late Mr. Arthur L. Leon amounting to some £20,000, for the promotion and encouragement of post-graduate or advanced research work, has been accepted with great appreciation.

The Court has appointed Mr. James Stinton Jones to be consultant engineer for heating, lighting, ventilation and electrical services generally, in connexion with the new buildings in Bloomsbury.

THE Salters' Institute of Industrial Chemistry is offering several fellowships for chemists of post-graduate training, and grants-in-aid to people employed in chemical works who desire to extend their education for a career in chemical industry. Further particulars can be obtained from the Director of the Institute, Salters' Hall, St. Swithin's Lane, London, E.C.4.

THE Cecil Peace Prize of £100 is offered annually to graduates or students in any university in Great Britain or Northern Ireland for the best essay on some subject connected with the maintenance of international peace. The subject for 1933 is "Is it true that the British Empire is in itself a League of Nations ?" Further particulars can be obtained from the Secretary, Universities Bureau of the British Empire, 88a, Gower Street, London, W.C.1.

THE annual examinations for a Faraday scholarship of eighty guineas per annum, tenable for two years at the Faraday House Electrical Engineering College and one year in manufacturing works, and for a Maxwell scholarship of sixty guineas per annum, tenable for two years at the College and one year in works, will be held at Faraday House on April 4–6. Further particulars can be obtained from the Registrar, Faraday House Electrical Engineering College, 62–70, Southampton Row, London, W.C.1.

THE University of Leeds has recently issued a list of holiday courses open to all students, whether former members of the University or not, to be given during the Easter vacation, on April 19–21. Amongst the courses are one on modern psychological principles by Dr. Ll. Wynn Jones and a course of six lectures in physics, comprised of two by Prof. R. Whiddington on "Recent Advances in our Knowledge of the Electron", two by Dr. E. C. Stoner on "Recent Developments in Magnetism", one by Mr. J. Ewles on "The Photoelectric Effect" and one by Mr. F. A. Long on "Recent Low Temperature Researches". Further information can be obtained from the Registrar of the University.

THE objectives of secondary education are being much discussed in the United States as well as in Great Britain. In the October number of *School Life*, the organ of the United States Federal Office of Education, appears an article by one of the senior staff on "Schools and the Social Upheaval" in which it is argued that a primary function of education, particularly in the high schools and colleges, is to prepare the rising generation for playing their part intelligently in the solution of social, economic and civic problems. Why should the people pay in taxation two and a half billion dollars yearly to support a public school system unless it believes that an educated public is the surest safeguard of its freedom ? It is because the high schools, patterned largely on the model of the colleges evolved to serve leisured and professional classes, have failed to adapt their teaching to the task of justifying this belief that the type of education they provide is being found inadequate to present-day needs. To fulfil their task of passing on the accumulated wisdom of one generation to the next the schools must expound the beliefs of acknowledged experts in regard to social and economic affairs, and in the readjustment now due, this function and character training should, it is contended, be treated as of paramount importance.

Calendar of Nature Topics

Ice off Newfoundland

March 20.—During the winter the sea is firmly frozen in Baffin Bay and among the islands of the Arctic Archipelago, and numerous icebergs calved from the glaciers of Greenland are frozen in. Early in spring these ice masses break up and drift into Davis Strait, where they are carried rapidly south-eastwards by the Labrador Current, drifting parallel with the coast of Labrador, and entering the Atlantic off Newfoundland. Here the thin ice-floes quickly disintegrate in the warm water, but the icebergs have a longer life, drifting in the eddying currents off Newfoundland and sometimes penetrating far into the Atlantic, where they constitute a grave danger to shipping. On April 14, 1912, the s.s. *Titanic* struck a berg in long. 41° 46′ N., lat. 50° 14′ W., and sank with great loss of life. Both the amount of ice and date of arrival vary greatly from year to year, but March 20 is about an average date for the bergs to appear in quantity over the Newfoundland Banks.

The Spring Equinox

March 21.—Although in the meteorological calendar spring begins on March 1, it is often nearer the close of the month before the earth begins to awake under the influence of rising temperature and increasing power of the sun's rays. The surface of the soil first responds to the greater insolation, and an apt saying relates that on St. Patrick's Day (March 17) "the warm side of a stone turns up", signifying that about this time heat begins to flow downwards into the ground from above instead of the ground giving up heat to the air.

Spring Winds and some Biological Effects

There is no doubt that wind, especially at certain seasons, is a factor of considerable ecological importance. South-westerly winds cause a drift of the zooplankton towards the eastern shore of the Southern Bight in spring, and herring coming in through the Straits of Dover naturally veer towards their food. The spring maximum, however, of the colonial flagellate *Phæocystis* occurs off the Dutch coast. This organism is disliked by herring. On meeting it in quantity, some of the shoals turn westwards toward English waters (Savage, *J. Ecol.*, 20, 2). Easterly winds on occasion bring the plankton towards the English coast. The herring follow, unless they are repelled by an accompanying drift of *Phæocystis* in excessive amount and continue north along the Dutch coast without appearing in the Lowestoft zone.

A succession of strong spring winds in many rivers produces a very heavy mortality among the emerging subimagines of the Ephemeroptera and seriously affects oviposition by the imagines. These insects are a favourite food of various fishes, especially of trout, and excessive losses leading to a reduced stock the following year imply an effect on the faunal balance in several ways.

Elvers Arrive

For three years the young of the fresh-water eel, in the strange form of leptocephali, have been drifting across the Atlantic Ocean from their distant birthplace, and now in the post-larval elver stage, they begin to enter the rivers of the western coasts of Europe.

In the Severn the fresh-water migration of the elvers begins in March and in such quantities do they appear that they become the objective of a seasonal fishery which lasts until about the middle of May. The elvers generally ascend the river on a high tide, swimming just below the surface of the water, and they are caught by means of hand-nets of cheese-cloth supported upon a large rectangular frame. Although the elver cake referred to by Isaac Walton and other writers is no longer made, the elvers themselves, packed in buckets or barrels, are still sold as food, the dish generally being prepared by washing the elvers in salt and water and afterwards boiling them in fat.

For many years the German Fisheries Union maintained an establishment at Epney on the Severn, from which they exported 3,000,000 living elvers annually for cultivation in German lakes and rivers. In 1920 this station was taken over by the Ministry of Agriculture and Fisheries, which endeavoured to encourage in Great Britain the introduction of eel stock to rivers and lakes otherwise unprofitable.

Since the eel-migration follows the trend of the North Atlantic drift, it is to be expected that the arrival of young eels in the North Sea will be later than on the west coast of Great Britain, so that in east coast rivers the beginning of the elver migration into fresh waters generally takes place in April or more commonly in May.

Barley

Few of our crops have been studied more than barley. As the raw material for the maltster, its quality takes on great importance, which when reflected in the price, causes farmers to think more about quality than yield. A good malting barley may be worth twice as much per quarter as a coarse sample only fit for feeding. Much work has recently been undertaken to define the illusive idea of quality in scientific terms as distinct from the hand valuation of the market place. The indications are that the good-looking barleys are somewhat favoured and the less attractive rather handicapped by judgment based on external appearance.

Of the factors making for quality in barley, soil and season are the most important and are outside the farmers' control. The choice of a suitable variety of seed is a great help; indeed two varieties alone account for most of the acreage in southern and eastern England, and represent a notable achievement in the production of new strains of cereals. Next comes skilful soil management, and he may count himself fortunate who can so lay his fields that the weather can do most of the work. Finally, there is the matter of manuring, and here the art lies in exploiting the crop-producing powers of fertilisers to the full without running the risk of seriously damaging the quality. It is fortunate that a good yield is not incompatible with a high grade product. It is essential, however, that the manure shall be so measured that the crop can stand up to harvest, and this requires considerable judgment. If the seed can be laid in a good seed bed in the early days of March, the first step towards a useful crop has been taken. The rest depends on the turn of the season.

Societies and Academies

DUBLIN

Royal Dublin Society, Jan. 24. C. BOYLE and J. J. RYAN: Grass silage. Experiments were carried out on the ensiling of grass in a concrete pit silo and on the feeding of the resulting silage to dairy cows. The first cutting was started when the grass had almost arrived at the stage when it might have been cut for hay. The second cutting was taken when the aftermath was about 9 in. long. A portion of each sample was analysed chemically and the remainder weighed and put into the silo in a bag. This was weighed and analysed when recovered. The loss in dry matter in the sample bags amounted to 15·8 per cent. To this must be added the loss due to some of the material on the top and sides being unfit for feeding. This brings the loss in dry matter up to 18·5 per cent. Three feeding trials were carried out in which silage was used to replace (*a*) hay, (*b*) roots, (*c*) hay and roots. Replacement values for hay, roots, and silage, were arrived at on the basis of starch equivalents: 3·2 lb. silage = 1 lb. hay, 0·43 lb. silage = 1 lb. roots, or 2½ stones silage = ½ stone hay and 2 stones roots. M. J. GORMAN: Two forms of sampler used in estimating the number of plants per acre in botanical analyses of grasslands. An account was given of several sizes and shapes of sampler used by various grassland workers. The advantages of taking 1/100,000 acre as a unit were pointed out. This size would be convenient for most purposes; where necessary, simple multiples or fractions of it might be employed. G. C. BROCK: A method of preparing a filter for the 3130 mercury line. A photographic lantern plate is exposed and developed in pyro soda or thiocarbamide developer. Reddish-brown or blue films are produced, and afterwards stripped from the glass. Such filters show a maximum of transmission near 3000 A., as in the case of sputtered silver films, but the absorption at 4000 A. is much higher. A red-brown filter which transmits approximately the same percentage as a sputtered filter at 3130 A., has a sharper cut-off on the visible side.

PARIS

Academy of Sciences, Jan. 30 (*C.R.*, 196, 305–376). The president announced the death of the Abbé Verschaffel, *Correspondant* for the Section of Astronomy. MARCEL BRILLOUIN: Linear partial differential equations in the plane. Domains with multiple connexion. The construction of integrals for given conditions at the boundaries. JULES DRACH: The integration by quadratures of the equation of geodesic lines. J. COSTANTIN: An attempt at a theory explaining the function of the mycorrhiza of the sugar cane. RENÉ LAGRANGE: The theorem of Poncelet. F. LEJA: A property of series of analytical functions limited on a curve. A. WEINSTEIN: The points of detachment of lines of slip. PIERRE GIRARD and CH. CHUKRI: A centrifuge without an axis of perfect stability and of high angular velocity. TCHANG TE-LOU: The measurement of the supply of heat in the cycle of an internal combustion engine with the aid of the indicator diagram. ANDRÉ EGAL: A new method of realisation of thermo-electric phenomena. The construction described and illustrated allows a large number of thermo-elements to be used in series, so arranged that the whole set is not put out of action when individual elements are damaged. V. DOLEJŠEK and K. DRAB: The study of the discharge in an ionic bulb with the aid of a cinematographic apparatus. V. POSEJPAL: The atomic radius of carbon in the diamond. In a recent paper on the passage of the photonic rays by atoms some formulæ have been deduced, and these are now applied to the determination of the atomic radius of carbon in the diamond. The close agreement of the values thus obtained with those given by X-ray methods is regarded by the author as a confirmation of the formulæ. The measurements on which the formulæ are based have nothing to do directly with atomic structure. P. ROUARD: The variations of phase by reflection on very thin metallic films. The metal was deposited by cathode sputtering in the form of a wedge, so that at one end the reflection was from glass to air and at the other from glass to metal. For silver, the change of phase was at first a retardation which, after passing through a maximum, diminishes and then becomes an advance. C. JAUSSERAN: The evolution of the latent image. The density is not sufficient to characterise a developed image. Moreover, the number of variables intervening in the evolution of the latent image are so numerous that it is difficult for different observers to work under absolutely identical conditions. LÉON GION: The photolysis of aqueous solution of ammonia. In the absence of oxygen, hydrogen and nitrogen are evolved, the ratio H/N varying from 2·4 to 3. A reducing substance is formed which is not a nitrite. NÉDA MARINESCO: The preparation of colloids by ultra-sonic dispersion. The method allows the preparation of a number of metallic colloids at the ordinary temperature in any dispersing medium: the particles are spherical and can be kept for a long time in this state. G. DARZENS and ANDRÉ LÉVY: Improvement of the general method of preparation of aldehydes by the degradation of acids. A modification of Blaise's method giving nearly quantitative yields. V. HASENFRATZ: Some properties of *d*-xylonic lactone—URIAN. A 1,6-dimethyl-1, 3, 5-hexatriene. VOLMAR and BETZ: Contribution to the study of emetic derivatives of lactic acid. Description of the preparation and properties of sodium antimoniolactate, $(C_3H_4O_3)_2NaH(SbOH)$. JACQUES DE LAPPARENT: The mica schists of Léon. RAYMOND CIRY: The upper Cretaceous of the western part of the province of Burgos. OTTO PETTERSSON: A gap in the classical theory of tides. E. FICHOT: Remarks on the preceding communication. PAUL BERTRAND: The morphological value of the primary rachis of the Cladoxyleæ and the Zygopterideæ. J. RAYMOND: The formation of the perithecium in *Microsphæra quercina*. A. GUILLIERMOND and R. GAUTHERET: The microchemical characters of the oxyflavonic compounds; their localisation in the vacuoles. The reactions of oxyflavonic compounds towards various reagents have been studied in the vacuole, in extracts and with the pure product. These are tabulated and compared with results for tannin in the vacuole and in solution. Although a single reagent has a limited value, with the tests taken together, oxyflavonic compounds can be identified and distinguished from tannin without difficulty. MLLE. S. NOUEL: Technique for the study of the eye muscles in Selacians. MLLE. ANNE RAFFY: The comparison of the respiratory metabolism of the eel at some stages of its development.

Cape Town

Royal Society of South Africa, Oct. 19. S. M. Naudé and J. E. C. Coventry: Intensity of cosmic radiation in South Africa. The results obtained in July, 1932, at eight different altitudes ranging from sea level (Cape Town) to 9,200 ft. (Mont-aux-Sources) show the usual increase of the intensity with the altitude, that is, with the fall of the barometric pressure. The graph of intensity/barometric pressure, for South Africa (mean latitude 28°S) lies between those representing Compton's determinations in New Zealand (42°S) and at a point 4°S, thus verifying the dependence of the intensity on the latitude. H. A. Shapiro: The kitchen-middens at Gordon's Bay. The bored-stone would seem to be a late addition to the kitchen-midden or 'strandloper' culture. Pottery would seem to be late, and is not present in all the middens. Previous to the appearance of these two elements the culture produced only formless stone instruments, shaped by their use, and without intention. The middens seem to overlie natural dunes. Two skeletons (the skulls having been removed some years before) were discovered. From Dr. D. Slome's description, these would fall within the San race.

Geneva

Society of Physics and Natural History, Dec. 15. H. Lagotala: The geology of the Comba region (north of Mindouli, French Equatorial Africa). The author continues the study of this region, formed by oolitic limestones and much folded siliceous limestones. M. Gysin: Petrographical researches in the Haut-Katanga. (1) Geological outline of the southern part of Haut-Katanga. The author gives a geological sketch of this region, which is 300 km. by 60 km. in extent. A series of geological maps (scale 1 in 20,000) have been drawn. R. Wavre: Polydromy of potentials and topology. M. Junquera: The combined influence of *p*H and glucose on the permeability of yeast to methylene blue. The addition of glucose in acid medium increases the staining effect of methylene blue on yeasts; the increase of coloration due to the glucose changes specifically in alkaline medium.

Rome

Royal National Academy of the Lincei, Nov. 6. L. Palazzo: Materials for the reconstruction of the magnetic maps of Italy: (4) Piedmont. U. Cisotti: Finite rigid displacements. G. Quagliariello: Presence in the bile of an enzyme which dehydrogenates stearic acid. Previous results have indicated that either the pancreatic juice or the bile contains a dehydrogenase capable of acting on higher fatty acids. Experiments with stearic acid show that such an enzyme occurs in the bile. R. Caccioppoli: A principle of inversion for functional correspondences and its applications to equations with partial derivatives (1). L. Chamard: (α) Points as described by Georges Durand. S. Cherubino: Further considerations on the classification of hyper-elliptic surfaces from the real point of view. B. Finzi: Vectorial tensors and their derivation. D. D. Kosambi: Differential geometry and calculus of variations. M. Kourensky: Integration of the equations to partial derivatives of the second order with two functions of two independent variables. (1) General case. G. Pfeiffer: (1) Simplification of L. Bianchi's investigations, generalising the character (S. Lie) that the parameters are essential. (2) Linearly independent solutions of the linear equations to the partial derivatives of the second order with two independent variables. A. Rosenblatt: The question of unicity for the solutions of equations to partial derivatives. B. Segre: Claim for priority. M. Gleijeses: Theory of 'wake' in perfect liquids; case of the circular cylinder. N. Carrara: Corollary to the theorem of the derivation of definite functions from integrals; application to the experimental methods of measuring physical magnitudes. E. Segrè: Quadrupole lines in X-ray spectra (2). Various theoretical considerations are discussed and an interpretation is given of the new experimental material which has been acquired during the past year and supports the attribution of the forbidden lines of X-rays to the irradiation of the quadrupole. P. Pratesi: Thiocyano- and thio-pyrroles, and pyrrole disulphides. By direct thiocyanation with an alkali thiocyanate and bromine, 2:4-dimethyl-3-carbethoxy-5-thiocyanopyrrole and 2:4-dimethyl-5-carbethoxy-3-thiocyanopyrrole have been obtained from the corresponding dimethylcarbethoxypyrroles. They are highly stable, crystalline compounds and may be used for the identification of the pyrrole derivatives. When reduced with zinc and acetic acid, they give the thiopyrroles in good yields. O. Renz: The tectonic position of the shaly clays between the mesozoic chain of Gubbio and the Tiber valley. M. Mitolo: Avitaminosis and intoxication. (1) Experimental polyneuritis and chemical intoxication from metals and metalloids. The nutritional deficiency of pigeons affected by experimental polyneuritis is enhanced by ingestion of mixtures of salts of various metals and metalloids in doses insufficient to produce poisoning in normal animals. Moreover, the harmful effect of the salts is also increased.

Vienna

Academy of Sciences, Nov. 17. Georg Koller and Gerhard Pfeiffer: (1) The constitution of pinastric acid. This acid, occuring, together with usnic and vulpic acids, in *Cetraria pinastri* and *C. juniperina*, has the empirical formula $C_{20}H_{16}O_6$ and yields anisic and benzoic acids on oxidation. On the basis of these and other reactions, two alternative structural formulæ are suggested for pinastric acid. (2) Glabratic acid. This acid, a constituent of *Parmelia glabra*, is identical with lecanoric acid. Eduard Haschek and Max Haitinger: A simple method of determining colour. By means of a method based on the Young-Helmholtz theory, photometric measurements under three filters give data which allow of the calculation of saturation and brightness. Leopold Kölbl: The northern edge of the Tauernfenster between Mittersill and Kaprum. Franz Grienl, Oswald Kofler and Maria Radda: Experiments on the relations between turbulence-friction and constitution of liquids. Max Pestemer and Oscar Platten: The conductivity of binary or ternary, partially miscible liquid mixtures with one component which is at least slightly electrolytic.

Nov. 24. Gustav Kürti: Magneto-rotation in coloured glass and rock salt. With these substances, no measurable alteration in the electromagnetic rotation of the plane of polarisation occurs as the result of intense Becquerel radiation. Herbert Schober: The spectra of rhenium: (3) the arc spectrum with copper electrodes in the visible region between 5400 and 4000 A. Alfred Pongratz and Alois Zincke: Investigations on perylene and its derivatives (39).

Forthcoming Events

Saturday, March 18

Royal Anthropological Institute, at 2.15.—(at St. John's College, Cambridge).—Dr. L. S. B. Leakey: *"Discoveries of Human Remains at Kanam and Kanjera (Kenya)"*.

Royal Institution, at 3.—Developments in Cinematography: A Display of Films, (1) Instructional Films.

Monday, March 20

University of London, at 4.30.—(at the Royal Veterinary College).—Sir Arnold Theiler: "The Pathology of Osteodystrophic Diseases of Domesticated Animals and their Causes" (succeeding lectures on March 21 and 23).

Royal Geographical Society, at 8.30.—M. Jean Delacour: "Some Contrasts in the Civilizations of Indo-China".

Friday, March 24

Royal Institution, at 9.—Lord Ashfield: "London Passenger Transport".

Saturday, March 25

Royal Institution, at 3.—Developments in Cinematography: A Display of Films, (2) Colour Films.

Official Publications Received

GREAT BRITAIN AND IRELAND

Reports of the Progress of Applied Chemistry. Vol. 17, 1932. Pp. 728. (London: Society of Chemical Industry.) 12*s.* 6*d.*; to Members, 7*s.* 6*d.*

The Economic Proceedings of the Royal Dublin Society. Vol. 2, No. 29: Factors affecting the Body or Viscosity of Cream and related Matters. By J. Lyons and G. T. Pyne. Pp. 461–500 + plate 29. 2*s.* Vol. 2, No. 30: The Influence of Agitation of Milk before Separation on the Fat Loss in the Skim Milk. By W. Finlay and J. Lyons. Pp. 501–513. 6*d.* (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 34: A Study of *Phoma Lingam* (Tode) Desm., and of the "Dry Rot" it Causes, particularly in Swede Turnips. By William Hughes. Pp. 495–520 + plates 46–47. 3*s.* 6*d.* Vol. 20 (N.S.), No. 35: A Classification of the Biological Elements, with a Note on the Biochemistry of Beryllium. By Dr. William Robert Fearon. Pp. 531–535. 6*d.* (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

University of London: University College. Annual Report, February, 1932–February, 1933. Pp. ii + 184. (London: Taylor and Francis.)

Journal of the Chemical Society. February. Pp. ii + 113–216 + viii. (London: Chemical Society.)

The Proceedings of the Physical Society. Vol. 45, Part 2, No. 247, March 1. Pp. viii + 135–365. (London: Physical Society.) 7*s.* net.

Journal of the Society of Glass Technology. Edited by Prof. W. E. S. Turner. Vol. 16, No. 64, December. Pp. xi + 77–93 + 375–477 + 395–575 + x + xxiv. (Sheffield: The University.) 10*s.* 6*d.*

Annual Reports on the Progress of Chemistry for 1932. Vol. 29. Pp. 344. (London: Chemical Society.)

University of Leeds. Twenty-eighth Report, 1931–32. Pp. 228. Publications and Abstracts of Theses by Members of the University during Session 1931–32. Pp. 26. (Leeds.)

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1931–1932. (Cmd. 4248.) Pp. 140. (London: H.M. Stationery Office.) 2*s.* net.

The Hannah Dairy Research Institute. Bulletin No. 5: The Nutritive Properties of Milk in relation to Pasteurisation; a Review of Existing Knowledge. By Dr. J. D. Stirling and Dr. J. H. Blackwood. Pp. 80. (Ayr.)

Department of Scientific and Industrial Research. Report for the Year 1931–32. (Cmd. 4254.) Pp. iv + 193. (London: H.M. Stationery Office.) 3*s.* net.

OTHER COUNTRIES

Cornell University: Agricultural Experiment Station. Bulletin 544: Co-operative Purchasing and Marketing Organisations in New York State. By F. A. Harper. Pp. 117. Bulletin 546: The Marketing of Milk thru Ice Cream. By M. C. Bond. Pp. 88. Bulletin 550: Soils in relation to Fruit Growing in New York. Part 2: Size, Production and Rooting Habit of Apple Trees on Different Soil Types in the Hilton and Morton Areas, Monroe County. By Joseph Oskamp and L. P. Batjer. Pp. 45. (Ithaca, N.Y.)

Sixième Congrès International du Froid, Buenos Aires, Août–Septembre 1932. Première Commission Internationale (Commission Kamerlingh Onnes) de l'Institut International du Froid. Rapports et communications issus du Laboratoire Kamerlingh Onnes présentés par le Président de la Première Commission, W. H. Keesom. Pp. x + 460. (Leiden: Eduard IJdo.)

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1930, under the direction of Dr. S. K. Banerji. Pp. iv + 149 + 5 plates. (Calcutta: Government of India Central Publication Branch.) 12.6 rupees; 20*s.*

Department of Marine, Canada. Monthly Record of Meteorological Observations in the Dominion of Canada, and in Bermuda and Newfoundland. September 1930. Pp. 53. (Ottawa: F. A. Acland.) 1 dollar per annum.

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 36: Fibre Boards, their Uses and the Possibilities of their Manufacture in Australia. By R. F. Turnbull. (Division of Forest Products, Technical Paper No. 6.) Pp. 51. (Melbourne: H. J. Green.)

Journal of Science of the Hiroshima University. Series B, Div. 1 (Zoology), Vol. 2, Articles 1–3, December. Pp. 47 + 8 plates (Tokyo: Maruzen Co., Ltd.). 95 sen.

Pamiętnik obchodu Pięćdziesięciolecia Kasy im. Mianowskiego, 1881–1931. Pp. ii + 88 + 4 plates. (Warszawa: Kasa imienia Mianowskiego.)

Proceedings of the American Academy of Arts and Sciences. Vol. 67, No. 11: The Eclipsing Binaries RW Arae and SW Ophiuchi. By Martha B. Shapley. Pp. 537–550. 40 cents. Vol. 67, No. 12: The Purification and Physical Properties of Organic Compounds, I: The Interpretation of Time-Temperature Curves in Freezing Point Determinations and as a Criterion of Purity. By Evald L. Skau. Pp. 551–576. 60 cents. (Boston, Mass.)

Publications of the Observatory of the University of Michigan. Vol. 5, No. 3: A Spectrographic Study of RT Aurigæ. By R. M. Petrie. Pp. 9–37. (Ann Arbor, Mich.)

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 710: Surface Water Supply of Hawaii, July 1, 1929, to June 30, 1930. Pp. v + 101. 10 cents. Water-Supply Paper 714: Surface Water Supply of the United States, 1931. Part 4: St. Lawrence River Basin. Pp. v + 160. 15 cents. Water-Supply Paper 719: Surface Water Supply of the United States, 1931. Part 9: Colorado River Basin. Pp. v + 121. 10 cents. Water-Supply Paper 721: Surface Water Supply of the United States, 1931. Part 11: Pacific Slope Basins in California. Pp. xi + 497. 50 cents. (Washington, D.C.: Government Printing Office.)

Education, India. Education in India in 1930–31. Pp. iv + 81. (Calcutta: Government of India Central Publication Branch.) 1.8 rupees; 2*s.* 6*d.*

Canada: Department of Mines: Mines Branch. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories) 1931. (No. 728.) Pp. iv + 183 + 2 plates. (Ottawa: F. A. Acland.)

Journal of the Indian Institute of Science. Vol. 15A, Part 8: Organic Manure from Sewage, Town Refuse and Waste Vegetation. By J. Jagannatha Rao and V. Subrahmanyan. Pp. 89–106. (Bangalore.)

Transactions of the Mining and Geological Institute of India. Vol. 27, Part 3, December. Pp. 155–260 + 5 plates. (Calcutta.) 4 rupees.

Science Reports of the Tokyo Bunrika Daigaku. Section *B*, No. 11: A Short Note on the Chromosomes of Crickets. By Hikokuro Honda and Shigemori Iriki. Pp. 133–135. (Tokyo: Maruzen Co., Ltd.) 10 sen.

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 5, No. 4: The Activation of Air by the Electrodeless Ring Discharge, by B. Arakatsu and K. Kimura; The Electrodeless Ring Discharge through Potassium Vapour, by B. Arakatsu and Y. Uemura. Pp. 143–161 + 4 plates. Vol. 5, No. 5: On the Anomalous Absorption of γ-Rays. By B. Arakatsu. Pp. 163–168. (Tokyo: Maruzen Co., Ltd.)

The Indian Forest Records. Vol. 17, Part 5: The Importance of the Origin of Seed used in Forestry. By H. G. Champion. Pp. vii + 76 + 12 plates. 2.12 rupees; 5*s.* Vol. 17, Part 6: New Cerambycidæ from India (Coleoptera.) By W. S. Fisher. Pp. ii + 8. 2 annas; 3*d.* Vol. 17, Part 4: The Sutlej Deodar, its Ecology and Timber Production. By Dr. R. Maclagan Gorrie. Pp. iv + 140 + 6 plates. 3.2 rupees; 5*s.* 6*d.* (Calcutta: Government of India Central Publication Branch.)

Union of South Africa: Department of Agriculture. Eighteenth Report of the Director of Veterinary Services and Animal Industry, Onderstepoort, Pretoria, August, 1932. Part 1. Pp. vii + 523. Part 2. Pp. 525–1094. (Pretoria: Government Printer.) 10*s.*

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Chemical Disarmament

BY the British Draft Convention submitted to the Disarmament Conference at Geneva on March 16 by Mr. MacDonald, chemical, incendiary and bacterial warfare is prohibited on the lines already accepted by the Conference. It is therefore of particular interest now to consider the replies of the Pilotti Special Committee to a questionnaire on chemical, incendiary and bacterial weapons submitted to this Committee by the Bureau of the Disarmament Conference. The Special Committee's report* is an important document, and its study should assist to engender a sane and healthy opinion on an essential aspect of disarmament.

The most important feature of the Committee's report as a whole is the emphasis it places on the intricate relations of chemical warfare and chemical industry. It points out, for example, in one of its major conclusions, that the prohibition of the manufacture, import and possession of apparatus and substances exclusively used for chemical warfare, while possible, would only be of limited value. The manufacture of those substances which were of any importance in war could be improvised by any State possessing a chemical industry. "Any such prohibition imposed upon a State would either be ineffective in practice, in view of the stocks held in industrial establishments, or it would inflict irreparable damage on the chemical industry."

It will be recalled that, in "The Riddle of the Rhine", Major Lefebure asserted that grave disparity in the strength of the chemical industry of different countries constitutes a definite menace to world peace, and the Pilotti Committee may at first sight appear to be endorsing Major Lefebure's views and those shared by many others having expert knowledge of chemical industry. Actually, however, the views thus presented are much more negative and pessimistic than those of Major Lefebure, and we question whether they would find widespread support in professional circles.

No sensible man denies the intimate connexion of chemical industry and chemical warfare or the folly of attempting under the guise of chemical disarmament to impose a rigid and bureaucratic control on chemical industry. Equally, however, no sensible man would forget, as the Pilotti Committee appears to have done, that the main concern of chemical industry is with peaceful industry, that unlike the armaments industry, it has no interests vested in war, and that, as Major Lefebure insists, the existence of large stocks of war chemicals used in industry has no meaning for war unless the appropriate containers or chemical weapons have been designed and put into stock in corresponding quantities.

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* Chemical, Incendiary and Bacterial Weapons Special Committee. Conf. D. 152. League of Nations Publications Department. (9) Disarmament, 9, 65. (London: G. Allen and Unwin, Ltd., 1932.)

It is this preoccupation of chemical industry with peacetime activities, on which its expansion and development mainly depend, that constitutes not merely an obstacle to thorough-going chemical disarmament but indeed the best hope of a satisfactory solution. If due precautions are taken against the growth in this field of interests directly concerned with the encouragement or expansion of chemical warfare, chemical industry should continue to exert, not an influence unfavourable to disarmament, but a safeguard to the disarmed State in the readiness with which in emergency its resources could be improved for its defence.

The Pilotti Committee asserts, and rightly, that interference with the legitimate stocks of material held by chemical industry is unjustifiable and dangerous. It fails to observe, however, that, apart from the question of containers and apparatus raised by Major Lefebure, the magnitude of such stocks is limited by the internal demands of industry itself. No industry accumulates stocks of any material under normal conditions in excess of those required to meet its normal manufacturing and sales demands, and the prohibition of the holding of stocks of war chemicals by State departments, if observed in good faith, should effectively prevent the growth of a direct interest in chemical warfare as a regular outlet for the products of chemical industry.

The close relation of chemical warfare to chemical industry makes this question of control of stocks the critical one and almost the only point at which definite control can be considered. There is, for example, in some quarters much excited talk about prohibiting chemical or other research which might facilitate preparation for or developments in chemical warfare. The Pilotti Committee in its report administers an effective cold douche to such talk when it points out the danger of any such prohibition preventing also chemical and pharmacological research, which forms an essential element in the development of insecticides, fumigants and fungicides, seed disinfectants, antiseptics, medicinals and drugs. Man cannot afford to relax his efforts to overcome the forces of Nature and to combat the scourge of disease.

Nor is research on protective apparatus or appliances for the use of poisonous substances any easier to single out for restriction or repression. Industry itself is continuously demanding the improvement and much more widespread use of protective devices like the gas mask, and impediments to research in this field would be purchased dearly by human suffering in industry. Similarly, the apparatus used for producing fungicidal or insecticidal sprays when combating diseases of plants can also be used for creating clouds of poisonous substances in warfare. Certain types of fire-extinguisher can readily be converted into flame-projectors which are equally effective for military purposes or for destroying locusts.

The Committee emphasises, therefore, the limited value of prohibition of the preparation, importation, exportation and possession of substances exclusively suitable for chemical warfare, in view of the impracticability of prohibiting research on either poisonous substances or protective or offensive apparatus which are of industrial significance. It makes, however, a most significant omission, for the report contains no reference whatever to the *ad hoc* establishments maintained by governments for research on chemical warfare. This is the point on which the advocates of chemical disarmament are likely to seize. If research in this field is of such industrial importance as is claimed for it, the work is more fittingly and efficiently carried on in industry than in a government establishment, where attention is at least liable to be concentrated on the military rather than the industrial aspects. If we are told that such work cannot be carried out in industry, we are inclined to suspect its real value to humanity and to maintain that a general agreement to discontinue all State research on chemical warfare, defensive or offensive, would provide a highly desirable obstacle to the rapid improvisement of chemical warfare in the event of hostilities.

The silence of the Committee on this important point is disappointing but its importance can be overstressed. Without entering on a discussion as to whether or not chemical warfare is the most humane means of conducting warfare, if warfare we must have, the value of chemical disarmament by itself is insignificant. The Committee renders a real service in its consistent emphasis upon the relation of chemical disarmament to general disarmament. It points out, for example, that by far the greater part of projectiles charged with poisonous substances in the War were projectiles of ordinary types; that it knows of no means of projection exclusively suitable for chemical warfare; ordinary guns may fire poisonous shells and ordinary aeroplanes transport receptacles filled with poisonous substances; and that these similarities destroy the practical value of any prohibition of training of armed forces in the use of chemical weapons. The troops are inevitably trained for chemical warfare in the normal course of their training.

The attempt to treat chemical warfare as a side issue is not only futile and misleading but may even have disastrous results. It can merely engender a false sense of security, and the major value of the Pilotti Committee's report lies in the convincing evidence it affords that chemical disarmament is only possible as part and parcel of a general and genuine disarmament scheme in every sphere. Given the good faith and genuine will to disarmament which is implicit in any such plan, chemical disarmament appears to present no real obstacle to progress, and could be effected without endangering security. While it is true, as the Committee observes, that the existence of an important chemical industry in any country permits the rapid improvisation and organisation of chemical warfare even when no special preparation has been made in peace time, the installation or adaptation and starting up of the manufacture of the necessary toxic materials on a large scale require a certain time, and this lag affords the check that is the essence of real disarmament.

The ease with which chemical industry can divert its energies to the production of munitions of war, whether in the sense of high explosives or chemical weapons, should not be allowed to obscure the fact that a definite time lag does in fact exist. The fundamental question is whether our national or international system is to be organised for peace or for war. If the answer is peace, the mere existence of widespread chemical industry preoccupied with the legitimate interests of commerce and industry, tempted by no outlets for its products for offensive purposes, offers a safeguard rather than a menace to the world, so long as that peace is organised and kept. The distribution of natural resources and chemical industry in the world is such as to ensure that any transgressor State must be in a position of technical inferiority to collective reprisals from the rest of the world.

The Pilotti Committee has prepared a report which, while of unequal merit, contrives to make certain essential points beyond question—chemical disarmament is not a matter to be discussed apart from the general question of disarmament, and no restrictions can be devised which, if mankind is so foolish as to perpetuate the present armed peace, can be effective to prevent the liberation of the destructive and terrifying forces of chemical warfare.

Innermost Asia

On Ancient Central-Asian Tracks: Brief Narrative of Three Expeditions in Innermost Asia and North-Western China. By Sir Aurel Stein. Pp. xxiv + 342 + 102 plates. (London: Macmillan and Co., Ltd., 1933.) 31*s.* 6*d.* net.

IT is just on a third of a century ago that Sir Aurel Stein began his exploration of 'innermost Asia'. By 1916 he had covered, on horse and foot, a distance in the aggregate of 25,000 miles in the course of three expeditions to Chinese Turkistan—the first in 1900–1, the second in 1906–8 and the third in 1913–16. It will be fresh in the memory of all that a fourth journey begun in 1930 proved abortive owing to the difficult attitude of Chinese authority.

The mere extent of the ground covered in these three expeditions, great as it may seem with such primitive means of transport—camel, pony and man—as alone were available, is but an imperfect gauge of Sir Aurel's achievement. The greatest powers of endurance and tenacity of purpose were needed to carry it through, in face of the trying climatic and geographical conditions. The discovery and excavation of these long-forgotten desert sites could be carried on only in winter. In part this was due to the heat of the summers, in part owing to the difficulty of transporting water in the desert in any form but that of blocks of ice. It is not surprising that the workmen were unable to endure more than a comparatively short period of continuous labour when exposed to the icy, sand-laden winds in a temperature that hovered normally somewhere about zero. It was in such conditions that Sir Aurel Stein secured a mass of geographical and topographical data and of archæological material which has enabled him to revive, like a palimpsest, a long and important forgotten chapter, or rather series of chapters, in the history of civilisations.

The results of Sir Aurel Stein's journeys in

Chinese Turkistan and the adjacent areas have already been made known to the scientific world in a series of carefully documented reports and in two volumes containing his personal narrative. Of the latter, one is out of print; of the former, those which are not out of print, if only on account of their cost, are beyond the reach of the ordinary individual. In the volume now before us, Sir Aurel has compiled a personal narrative which forms a composite picture. In this, ignoring chronological order, he conducts his readers over the whole of the ground traversed in geographical sequence, and describes in sufficient detail each of the sites excavated as well as the principal results. He has in this manner made the complete circuit of Chinese Turkistan, with a detour into China proper, starting from Kashmir and returning along the foot of the T'ien Shan on the northern boundary to cross the Pamirs. The wider public to whom this personal narrative will be accessible owes the author a debt of gratitude that, amid the labours and disappointments of the last few years, he should have had the courage and energy to prepare and see through the press a work which will admit them to an intimate view of his great achievement.

The scientific results—topographical, geographical and archæological—of the three journeys were remarkable. They are too extensive for even bare enumeration here; but it may not be out of place to note one or two of the more outstanding. Much unsurveyed country was mapped—in the Nan-shan ranges alone some 24,000 miles were covered by plane-table—and much unexplored country was crossed, this more particularly on the northern boundary, a journey which was illuminating in the light it threw on the activities of the Mongols. No less interesting were the historico-topographical results, especially in the ancient Lou-Lan, by which were verified the records of early Chinese travellers and of the Imperial annals. They fully bear out the evidence which had made this desert the great artery joining China to the West, and showed that it had been held in turn by garrisons of Chinese, Indo-Scythians, and Tibetans, as well as the later Huns, Turks and the great Manchu emperors of China in the eighteenth century.

One of the problems upon which Sir Aurel's investigation has an important bearing is that of the causes which have led to the destruction of these sand-buried cities and the disappearance of the oases of the Tarim basin in which they stood. He holds the view that the evidence does not point to any continuous and progressive desiccation due to climatic variation, such as has been postulated; climatic conditions evidently have remained unchanged for centuries. It would appear that fertility depended upon irrigation, which became disorganised in unsettled political conditions and thus allowed desert conditions to prevail once more. On the other hand, he accepts the hypothesis that shrinkage of the glacier-fed rivers, which now makes any revival of fertility impossible, may be due to the gradual disappearance of the 'fossil' ice left from glaciations of the Ice Age.

In archæology, the thrills of discovery abound. From the first find of Buddhist art in Khotan—the first indication of the all-pervading influence of Western art, Iranian, Greek, Græco-Buddhist, in the Tarim basin and beyond—and the clay-sealed wooden documents at Niya, the interest rises until it culminates in the revelations of the store-chamber in a cave-temple in the oasis of Tun-Huang, in which were early Chinese, Buddhist and other writings and Buddhist paintings on silk of the T'ang period. Of these a rich store ultimately found a resting place in the British Museum. They have provided a mine for the delving of scholars over a long period of years and are still not exhausted. The wooden official documents, of which some of the sealings are pure Greek in subject, have been found to contain the earliest known examples of the Indian Karoshthi script, dating from the early centuries of our era; while among the documents from Tun-Huang are languages previously unknown, one of them, Tokharian, an Aryan language, which exhibits the anomalous feature that its affinities are with the western group of those languages, rather than with the eastern.

It is clear from internal evidence that Sir Aurel's expeditions were brought to a successful end only by the most careful organisation. This serves to emphasise a fact which is inevitably borne upon the reader of his book. The great Chinese expedition to Farghana of an army of 60,000 men, of whom 30,000 were successfully brought across the desert, under the Han dynasty, the maintenance of a system of desert forts, and the building of a protective wall, of which Sir Aurel traced the course for four hundred miles from the Su-lo-ho basin to the Etsin-gol, all bear witness to the organising ability and powers of recuperation of the Chinese. It seems to afford some justification for those of them who now regard the present situation, which for any other people might be looked upon as crushing, as no more than a phase which will pass.

It is no exaggeration to say that Sir Aurel Stein's record will rank with the great books of travel. In point of style it contains what is probably his best work. A restrained but vivid narrative sustains its interest from the first page to the last. No little praise is due to his publishers, who evidently have spared no pains to give his story a worthy setting. Few if any books of travel and archæological exploration have been more liberally and adequately illustrated, while the reproductions in colour of Buddhist paintings deserve the highest commendation.

Old Wine and New Bottles

A Text-Book of Physical Chemistry. By Dr. J. Newton Friend. (Griffin's Scientific Text-Books.) Vol. 1: *General Properties of Elements and Compounds.* Pp. xii+501. (London: Charles Griffin and Co., Ltd., 1932.) 24*s.* net.

"WENT to the Royal Institution last night in hopes of hearing Faraday lecture, but the lecture was given by Mr. Pereira upon crystals, a subject of which he appeared to be master, to judge by his facility and fluency. . . . Met Dr. Buckland and talked to him for an hour, and he introduced me to Mr. Wheatstone, the inventor of the electric telegraph. . . . There is a cheerfulness, an activity, an appearance of satisfaction in the conversation and demeanour of scientific men that conveys a lively notion of the *pleasure* they derive from their pursuits."

Thus far the author of the Greville memoirs under date March 17, 1838.

Nearly a century has passed, and a modern lecture on crystals, still most appropriately given at the lecture table of the Institution, would reveal secrets of atomic structure far transcending the scope of the discourse of the learned Dr. Jonathan Pereira; nevertheless, our men of science bear very lightly the vast weight of a century's accumulated knowledge, and cheerfulness and activity still dominate the conversations of the Royal Institution.

They who work on border-line subjects may be expected to feel most heavily the pressure of this accumulation. The physical chemist of to-day has to be both physicist and mathematician, at home with the developments of quantum theory, and competent to handle the theorems of statistical mechanics. Withal, there is scarcely anything of the older knowledge which he can afford to shed, and it will be an ill day for him when he loses the outlook peculiar to the chemist. The phase rule and Le Chatelier's theorem are weapons as potent as ever they were; and the skilled chemist must have at command much detailed knowledge of thermal and optical quantities, of surface and viscous forces, of equations of state and kinetic theory; in short, he must be well acquainted with the topics discussed in the first volume of Dr. Newton Friend's treatise, and with much besides.

In a brief review, it is impossible to do more than to summarise the headings of the twenty-two chapters which the book comprises—elementary kinetic theory, vapour pressure, critical phenomena and gas liquefaction, change of state, volume relations, the crystalline state, viscosity, surface tension, optical properties, solubility, diffusion, osmosis, adsorption and the colloidal state are chief among the properties dealt with in this first volume.

It is significant that, with such a list of subjects under review, the general index to the volume contains no entry under the heading 'quantum', nor are the names Debye, Einstein and Bragg listed. It must be said emphatically that this remark is not made by way of criticism—it serves merely to show that, in this volume at least, the author is concerned to deal with that mass of basic older knowledge with which every chemist may be expected to be conversant.

The treatment of these topics is, within the limits indicated, fairly full, though on the whole elementary in outlook. It would surely save time and trouble if, for example, the 'equal-root' method of deducing the critical constants in terms of those of the equation of state were abandoned for the more general method which involves writing down the analytical condition for a point of inflexion with a horizontal tangent. Not every equation of state is a cubic equation.

Two minor points may be noted. In the diagram on p. 99 representing the law of rectilinear diameters, the diameter is surely sloping the wrong way (compare van't Hoff, "Vorlesungen", vol. 3, p. 19). Again (p. 262), we read that the general relation connecting surface tension and temperature is

$$\sigma = \sigma_0 \ (1 - \alpha t + \beta t^2),$$

which it certainly is not.

The remaining volumes of Dr. Friend's treatise will be awaited with interest.

ALLAN FERGUSON.

Cantor: the Mathematician of the Infinite

Georg Cantor Gesammelte Abhandlungen: Mathematischen und philosophischen Inhalts mit erläuternden Anmerkungen sowie mit Ergänzungen aus dem Briefwechsel Cantor-Dedekind. Herausgegeben von Ernst Zermelo. Nebst einem Lebenslauf Cantors von Adolf Fraenkel. Pp. vii + 486. (Berlin: Julius Springer, 1932.) 48 gold marks.

"INFINITY," wrote the schoolboy, "is the place where things happen that don't." Similar opinions concerning the paradoxes which arise from the consideration of the infinite and the infinitesimal have been expressed for more than two thousand years. About 450 B.C., Zeno put forward four such paradoxes, of which the best known is "Achilles and the Tortoise". In the seventeenth and eighteenth centuries infinity and the infinitesimal were used very recklessly, and when at last mathematicians sought to return to the Greek standard of accuracy, they were unanimous in rejecting the use of infinity as something completed. But what all had rejected Cantor chose as his foundation stone.

Georg Cantor was born in 1845 at St. Petersburg, the son of a Dane. Georg soon showed an intense interest in mathematics, but was compelled to study engineering. His love for mathematics continued, and his father at last agreed that he should devote himself to it. In 1863 he went to Berlin, where Kummer, Weierstrass and Kronecker were professors. He obtained his Ph.D. degree in 1867, and one of his theses was that "in mathematics it is more important to state a question properly than to solve it". Actually the great importance of his later work lay more in the ideas and notation than in the actual results. In 1869 he became *privatdozent* at Halle, afterwards obtaining a professorship. In 1872 he produced his well-known theory of irrational numbers, published about the same time as the similar theories of Méray, Weierstrass and Dedekind, who share the credit of clearing up difficulties that had lasted from the time of the Greeks.

Cantor will be for ever famous as the creator of the theory of aggregates. This met with much opposition, especially from Kronecker, to whom Cantor's 'actual infinity' seemed a gratuitous return to the old errors which had corrupted mathematics for so long. Cantor was deeply distressed by this opposition, and in 1884 he suffered a mental breakdown, which recurred from time to time up to his death in 1918.

Some of Cantor's ideas can be understood by those with no knowledge of mathematics. In what follows some modifications due to Hobson have been incorporated. Consider the positive integers, 1, 2, 3 . . . This is an example of an *infinite aggregate,* which has the special property of being *simply ordered*; that is, given any two elements, we can tell which comes before the other. It has the further property of having a first element, and every other aggregate formed by taking part of the whole has the same property. Such aggregates are called *well-ordered.* A second simply ordered infinite aggregate that is also well-ordered is given by the even positive integers, 2, 4, 6 . . . These two aggregates are said to be *equivalent,* that is, there is a one-to-one correspondence between the elements of each, so the whole is equivalent to its part! In this case the equivalence is of a special kind known as *similarity,* that is, the corresponding elements occur in the same order. All simply ordered aggregates which are similar to one another are said to have the same *order-type.* The order-type of our first example, and so also of our second, is denoted by ω. The order-type of a well-ordered aggregate is called its *ordinal number,* so ω is a *transfinite* ordinal number.

A third aggregate, of a different kind, is formed by the positive rational numbers, for example, two-sevenths, three-fifths. If the elements are arranged in order of magnitude the aggregate is simply ordered, as we can tell which of two numbers is the smaller, but not well-ordered, as there is no first term, for given any rational number we can find a smaller one; the aggregate is *everywhere dense,* that is, given any two rational numbers, we can find others lying between them. This aggregate is not similar to the first or second, but let us re-arrange it as follows:

$$\tfrac{1}{1}\ ;\ \tfrac{1}{2}\ ,\ \tfrac{2}{1}\ ;\ \tfrac{1}{3}\ ,\ \tfrac{3}{1}\ ;\ \tfrac{1}{4}\ ,\ \tfrac{2}{3}\ ,\ \tfrac{3}{2}\ ,\ \tfrac{4}{1}\ ;\ \ldots$$

so that the sum of the numerator and denominator is 2, 3, 4 . . . in the first, second, third . . . group; each group contains a finite number of elements, arranged in order of magnitude. This fourth aggregate is simply ordered and well-ordered; it is also similar to our first and second. The third is equivalent to the others, but not similar to them.

Aggregates which are equivalent are said to have the same *power* or *cardinal number.* Aggregates equivalent to our first are called *enumerable,* and their cardinal number is denoted by *a* or by *Alef-zero*. Cantor's first great discovery was that the aggregate of all real algebraic numbers, that is, the real roots of algebraic equations with integral coefficients, is enumerable, but the aggregate of *all* real numbers (including non-algebraic irrationals such as π and e) is not. The cardinal number of the latter aggregate is called the *power of the continuum*, and is denoted by c. It corresponds to the infinite set of points in either a finite or infinite straight line, and, strange to say, also to those in a square or cube. The attempt to find cardinal numbers greater than c leads to the general theory of transfinite numbers.

Burali-Forti's discovery in 1897 (anticipated by Cantor in 1895) that the theory of transfinite ordinal numbers led to a paradox, started a controversy that is not yet settled. Some say, with Poincaré, "There is no actual infinity. The Cantorians have forgotten this and so have fallen into contradiction." Others, such as Zermelo, believe that Cantor's work, although defective as it stands, can be made sound by the explicit postulation of a suitable set of axioms, but no such set has yet been universally accepted. Many consider that some of Cantor's definitions, which do not tell us how to construct the entities in question, contain latent self-contradictions. Whatever view is taken on these questions, Cantor's more elementary ideas have become indispensable in the exact formulation of results in analysis and geometry.

H. T. H. PIAGGIO.

Short Reviews

Physical Chemistry. By Prof. Dr. John Eggert. Translated by Dr. S. J. Gregg. A translation of the third edition of "Lehrbuch der physikalischen Chemie" revised in collaboration with Prof. Dr. Lothar Hock. Pp. xi + 632. (London: Constable and Co., Ltd., 1932.) 24*s*. net.

THE third edition of Prof. Eggert's "Physical Chemistry" has been translated by Dr. Gregg, of King's College, London. The book is divided into three parts. The first part on "Atomics and Energetics" includes sections on classical chemical theory, thermodynamics, kinetic theory and quantum theory, all treated very briefly in about eighty pages. The second part, on "The Nature of Matter", occupying about 230 pages, is divided into three main sections, atoms, molecules and states of aggregation. The third part, on "Chemical Reactions" which occupies the remaining half of the book, has five main sections, on chemical equilibrium, thermochemistry, electrochemistry, chemical kinetics and photochemistry.

In general, Prof. Eggert's book deals only briefly with the topics which were taught under the name of physical chemistry during the pre-War period; but it describes much more fully the themes which have been developed during the subsequent years. There are thus ample references to electrons, isotopes, atomic and molecular spectra, crystal lattices, strong electrolytes, activity coefficients, active molecules and chain reactions, whilst the properties of dilute aqueous solutions and the theory of electrolytic dissociation no longer occupy the predominant position which was given to them in earlier textbooks. This change of emphasis corresponds with the liberation of physical chemistry from the limitations of the preceding decades; and the wide outlook of the present volume is an indication of the debt which chemists owe to an inrush of sound physics into their science.

The English version of Prof. Eggert's book may indeed be welcomed because it presents a readable and attractive account of the 'chemical physics' by which the rudimentary 'physical chemistry' of the preceding generation has now been so largely replaced.

A Textbook of Pharmacognosy. By J. W. Cooper and T. C. Denston; with Illustrations and Drawing Notes by M. Riley. Pp. x + 298. (London: Sir Isaac Pitman and Sons, Ltd., 1931.) 10*s*. 6*d*. net.

ALTHOUGH the title of this book is a little misleading—it should surely have been "A Textbook of Practical Pharmacognosy", according to the very principle laid down in the authors' preface—its use will probably extend well beyond the circle of students for whom it is primarily intended. In that sense, it may well act as a substitute for larger works of reference on the shelves of those who have only occasionally to tackle the description and identification of natural drugs.

For these, however, the purely haphazard arrangement of plant families, varying in the different sections (occasionally even two representatives of one family occur in different places in the same section), is a disadvantage only partly set off by a good index. Surely some standard arrangement, such as that of Bentham and Hooker, could have been used throughout. The drawings, on the other hand, should be of good service to users of the book, though a few that have been omitted might well be included (for example, *Chiretta*, for comparison with *Lobelia*).

The tests described are comprehensive and well explained, even if the advertisement of a particular brand of malt extract (p. 4) seems a little gratuitous; there are plenty of other diastatic extracts on the market. Print and binding are of the quality that a reference book needs—simple, clear and durable.

A. L. B.

Elementary Trigonometry. By Dr. John Prescott and H. V. Lowry. Pp. xi+444. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 5*s.*

IN this volume the authors "have tried to recapture the spirit of some of the writers of a few generations ago who looked on Trigonometry as a branch of applied rather than of pure mathematics". The course mapped out is therefore different in many ways from that found in most other textbooks. Great stress is laid on "the kind of calculations and manipulations of trigonometric expressions that occur in the applications of the subject". Theory is not neglected, but it only enters where it is necessary to establish practical formulæ. The scope is fairly wide and includes an excellent section on mensuration and solid geometry. A welcome feature is the introduction of radian measure at the beginning.

Cartesian geometry is freely used in establishing many of the standard theorems, and special attention is given to graphs and their uses. A novel feature is the addition of an appendix in which is discussed a geometrical method of calculating π to any degree of accuracy without using trigonometry.

Whilst many teachers may not agree with the general treatment, yet they will find much to stimulate interest together with a good selection of exercises, many of which are of an unusual type.

General Science. By F. Fairbrother and E. Nightingale. Part 1. Pp. viii+136. (London: G. Bell and Sons, Ltd., 1932.) 2*s.* 3*d.*

GENERAL agreement is now reached upon the importance of giving all normal pupils in all schools some instruction in the nature of the environment in which their lives must be spent. For this purpose courses have to be planned which shall give the elements of physics, chemistry, biology, geology and astronomy. Until much more experience has been gained there is likely to be great diversity in such proposed courses.

The physical and chemical parts proposed by Fairbrother and Nightingale begin with experiments on the Bunsen burner, combustion, distillation and crystallisation. Then follows the measurement of length, area, volume and density and experiments on buoyancy and flotation. Thermal expansion, thermometry, pressure in liquids and in the atmosphere and the chemistry of the air complete the first part of the course, which is well illustrated by clear diagrams and everyday applications.

At present the value of any course in general science can be assessed only by the user—so much depends upon the teacher—and it is to be hoped that bold experimentation in the choice and treatment of topics will not be cramped by external examination systems and will lead to the production of many books of a standard similar to the present one.

An Introduction to Organic Chemistry. By Prof. Ira D. Garard. Pp. ix+296. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 16*s.* 6*d.* net.

THIS is an expensive introduction to organic chemistry, which does not offer any particularly novel features. The type of treatment is indicated by the first few chapter headings, which run as follows: introduction, methane and related compounds, alcohols and ethers, halogen derivatives of the paraffins, unsaturated hydrocarbons, aldehydes and ketones. The descriptive work is well done, and the accompanying graphic formulæ are set out very clearly. Some of the space devoted to the accounts of individual substances might have been used to greater advantage in a fuller exposition of such general matters as the fundamental principles of stereochemistry and the nature of cyclic compounds. Thus, the constitutions of quinoline, isoquinoline, and more complex heterocyclic substances are presented without explanation before benzene has been discussed; and even when benzene is reached, its constitution receives scant attention. The final chapter contains laboratory directions for twenty-eight simple experiments in organic chemistry. The book contains fifteen diagrams, mostly of apparatus.

Foundations and Methods of Chemical Analysis by the Emission Spectrum. Being the authorised translation of "Die chemische Emissionsspektralanalyse" by Dr. Walther Gerlach and Dr. Eugen Schweitzer. Pp. 123. (London: Adam Hilger, Ltd., n.d.) 12*s.* 6*d.* net.

To a large extent this book consists of a summary of original researches carried out by the joint authors and published in the *Zeitschrift für anorganische und allgemeine Chemie.* It affords an authoritative account of the principles and practice of spectrographic analysis, and there are chapters dealing with the electrical and optical apparatus used in analysis by the emission spectrum, qualitative analysis, quantitative analysis, experiments on the refinement of the method by photometric intensity measurements, and special problems. Many of the points here presented have hitherto appeared only in the periodical literature. The book is well printed and illustrated, and it will be found helpful and suggestive to all who are interested in spectrographic methods.

An Agricultural Atlas of England and Wales. Second edition, revised. Made on behalf of the Agricultural Economics Research Institute, University of Oxford, by Malcolm Messer. Published by direction of the Ministry of Agriculture and Fisheries. Pp. iv+25+3 maps. (Southampton: Ordnance Survey Office, 1932.) 10*s.* net.

THE present re-issue of this atlas is based on the agricultural returns for 1928. The area of each map now includes the Channel Islands and additional maps show the distribution of agricultural labour, sugar-beet and poultry.

Light and Life[*]

By PROF. N. BOHR, For.Mem.R.S.

AS a physicist whose studies are limited to the properties of inanimate bodies, it is not without hesitation that I have accepted the kind invitation to address this assembly of scientific men met together to forward our knowledge of the beneficial effects of light in the cure of diseases. Unable as I am to contribute to this beautiful branch of science that is so important for the welfare of mankind, I could at most comment on the purely inorganic light phenomena which have exerted a special attraction for physicists throughout the ages, not least owing to the fact that light is our principal tool of observation. I have thought, however, that on this occasion it might perhaps be of interest, in connexion with such comments, to enter on the problem of what significance the results reached in the limited domain of physics may have for our views on the position of living organisms in the realm of natural science.

Notwithstanding the subtle character of the riddles of life, this problem has presented itself at every stage of science, since any scientific explanation necessarily must consist in reducing the description of more complex phenomena to that of simpler ones. At the moment, however, the unsuspected discovery of an essential limitation of the mechanical description of natural phenomena, revealed by the recent development of the atomic theory, has lent new interest to the old problem. This limitation was, in fact, first recognised through a thorough study of the interaction between light and material bodies, which disclosed features that cannot be brought into conformity with the demands hitherto made to a physical explanation. As I shall endeavour to show, the efforts of physicists to master this situation resemble in some way the attitude which biologists more or less intuitively have taken towards the aspects of life. Still, I wish to stress at once that it is only in this formal respect that light, which is perhaps the least complex of all physical phenomena, exhibits an analogy to life, the diversity of which is far beyond the grasp of scientific analysis.

From a physical point of view, light may be defined as the transmission of energy between material bodies at a distance. As is well known, such an energy transfer finds a simple explanation in the electromagnetic theory, which may be regarded as a direct extension of classical mechanics compromising between action at a distance and contact forces. According to this theory, light is described as coupled electric and magnetic oscillations which differ from the ordinary electromagnetic waves used in radio transmission only by their greater frequency of vibration and smaller wave-length. In fact, the practically rectilinear propagation of light, on which rests our location of bodies by direct vision or by suitable optical instruments, depends entirely on the smallness of the wave-length compared with the dimensions of the bodies concerned, and of the instruments.

The idea of the wave nature of light, however, not only forms the basis for our explanation of the colour phenomena, which in spectroscopy have yielded such important information of the inner constitution of matter, but is also of essential importance for every detailed analysis of optical phenomena. As a typical example, I need only mention the interference patterns which appear when light from one source can travel to a screen along two different paths. In such a case, we find that the effects which would be produced by the separate light beams are strengthened at those points on the screen where the phases of the two wave trains coincide, that is, where the electric and magnetic oscillations in the two beams have the same directions, while the effects are weakened and may even disappear at points where these oscillations have opposite directions, and where the two wave trains are said to be out of phase with one another. These interference patterns have made possible such a thorough test of the wave nature of the propagation of light, that this conception can no longer be considered as a hypothesis in the usual sense of this word, but may rather be regarded as an indispensable element in the description of the phenomena observed.

As is well known, the problem of the nature of light has, nevertheless, been subjected to renewed discussion in recent years, as a result of the discovery of a peculiar atomistic feature in the energy transmission which is quite unintelligible from the point of view of the electromagnetic theory. It has turned out, in fact, that all effects of light may be traced down to individual processes, in each of which a so-called light quantum is exchanged, the energy of which is equal to the product of the frequency of the electromagnetic oscillations and the universal quantum of action, or Planck's constant. The striking contrast between this atomicity of the light phenomena and the continuity of the energy transfer according to the electromagnetic theory places us before a dilemma of a character hitherto unknown in physics. For, in spite of the obvious insufficiency of the wave picture, there can be no question of replacing it by any other picture of light propagation depending on ordinary mechanical ideas.

Especially, it should be emphasised that the introduction of the concept of light quanta in no way means a return to the old idea of material particles with well-defined paths as the carriers of the light energy. In fact, it is characteristic of all the phenomena of light, in the description of which the wave picture plays an essential rôle, that any attempt to trace the paths of the individual light quanta would disturb the very phenomenon under investigation; just as an interference pattern would completely disappear, if, in order to make sure that the light energy travelled only along one of the two paths between the source and the screen, we should introduce a non-transparent body into one of the paths. The spatial continuity of light propagation, on one hand, and the atomicity of the light effects, on the other hand, must, therefore, be considered as complementary aspects of one reality, in the sense that each expresses an important feature of the phenomena of light, which, although irreconcilable from a mechanical point of view, can never be in direct contradiction, since a closer analysis of one or the other feature in mechanical terms would demand mutually exclusive experimental arrangements.

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[*] Address delivered at the opening meeting of the International Congress on Light Therapy, Copenhagen, on August 15, 1932. The present article, conforming with the Danish version (*Naturens Verden*, 17, 49), differs from that published in the Congress report only by some formal alterations.

At the same time, this very situation forces us to renounce a complete causal description of the phenomena of light and to be content with probability calculations, based on the fact that the electromagnetic description of energy transfer by light remains valid in a statistical sense. Such calculations form a typical application of the so-called correspondence argument, which expresses our endeavour, by means of a suitably limited use of mechanical and electromagnetic concepts, to obtain a statistical description of the atomic phenomena that appears as a rational generalisation of the classical physical theories, in spite of the fact that the quantum of action from their point of view must be considered as an irrationality.

At first sight, this situation might appear very deplorable; but, as has often happened in the history of science, when new discoveries have revealed an essential limitation of ideas the universal applicability of which had never been disputed, we have been rewarded by getting a wider view and a greater power of correlating phenomena which before might even have appeared as contradictory. Thus, the strange limitation of classical mechanics, symbolised by the quantum of action, has given us a clue to an understanding of the peculiar stability of atoms which forms a basic assumption in the mechanical description of any natural phenomenon. The recognition that the indivisibility of atoms cannot be understood in mechanical terms has always characterised the atomic theory, to be sure; and this fact is not essentially altered, although the development of physics has replaced the indivisible atoms by the elementary electric particles, electrons and atomic nuclei, of which the atoms of the elements as well as the molecules of the chemical compounds are now supposed to consist.

However, it is not to the question of the intrinsic stability of these elementary particles that I am here referring, but to the problem of the required stability of the structures composed of them. As a matter of fact, the very possibility of a continuous transfer of energy, which marks both the classical mechanics and the electromagnetic theory, cannot be reconciled with an explanation of the characteristic properties of the elements and the compounds. Indeed, the classical theories do not even allow us to explain the existence of rigid bodies, on which all measurements made for the purpose of ordering phenomena in space and time ultimately rest. However, in connexion with the discovery of the quantum of action, we have learned that every change in the energy of an atom or a molecule must be considered as an individual process, in which the atom goes over from one of its so-called stationary states to another. Moreover, since just one light quantum appears or disappears in a transition process by which light is emitted or absorbed by an atom, we are able by means of spectroscopic observations to measure directly the energy of each of these stationary states. The information thus derived has been most instructively corroborated also by the study of the energy exchanges which take place in atomic collisions and in chemical reactions.

In recent years, a remarkable development of the atomic theory has taken place, which has given us such adequate methods of computing the energy values for the stationary states, and also the probabilities of the transition processes, that our account, on the lines of the correspondence argument, of the properties of atoms as regards completeness and self-consistency scarcely falls short of the explanation of astronomical observations offered by Newtonian mechanics. Although the rational treatment of the problems of atomic mechanics was possible only after the introduction of new symbolic artifices, the lesson taught us by the analysis of the phenomena of light is still of decisive importance for our estimation of this development. Thus, an unambiguous use of the concept of a stationary state is complementary to a mechanical analysis of intra-atomic motions; in a similar way the idea of light quanta is complementary to the electromagnetic theory of radiation. Indeed, any attempt to trace the detailed course of the transition process would involve an uncontrollable exchange of energy between the atom and the measuring instruments, which would completely disturb the very energy transfer we set out to investigate.

A causal description in the classical sense is possible only in such cases where the action involved is large compared with the quantum of action, and where, therefore, a subdivision of the phenomena is possible without disturbing them essentially. If this condition is not fulfilled, we cannot disregard the interaction between the measuring instruments and the object under investigation, and we must especially take into consideration that the various measurements required for a complete mechanical description may only be made with mutually exclusive experimental arrangements.

In order fully to understand this fundamental limitation of the mechanical analysis of atomic phenomena, one must realise clearly, further, that in a physical measurement it is never possible to take the interaction between object and measuring instruments directly into account. For the instruments cannot be included in the investigation while they are serving as means of observation. As the concept of general relativity expresses the essential dependence of physical phenomena on the frame of reference used for their co-ordination in space and time, so does the notion of complementarity serve to symbolise the fundamental limitation, met with in atomic physics, of our ingrained idea of phenomena as existing independently of the means by which they are observed.

(*To be continued.*)

Phases in South African Locusts

THE theory of phase variation in swarming locusts was first put forward about ten years ago, since when a considerable amount of data has been accumulated in its support. Most of the evidence, however, was either based on direct field observations, or on small-scale experiments which served only to prove the fact of the transformation from the solitary to the gregarious phase, and vice versa, but were insufficient for analytical study of the phenomenon and of its underlying causes. This gap has now been filled by a paper by Prof. J. C. Faure recording the results of four years' experimental studies on the phases of four species of locusts occurring in South Africa.*

The bulk of the experiments refer to the well-known brown locust of South Africa (*Locustana pardalina*, Wlk.), and most of them were repeated on the tropical migratory locust (*Locusta migratoria migratorioides*, R. and F.) which swarmed over enormous areas of the African continent last year; some corroboration of the results was obtained also from studies on the desert locust (*Schistocerca gregaria*, Forsk.) and the red locust (*Nomadacris septemfasciata*, Serv.).

The main result of the numerous breeding experiments made under a great variety of conditions is a final proof that the phase transformation is a scientific fact which can no longer be doubted. Indeed, Prof. Faure succeeded in producing the swarming phase from the solitary one, and vice versa, in the case of every species experimented upon.

Turning to the problem of the mechanism and the causes of the transformation, Prof. Faure's experiments confirm beyond doubt the importance of the density of the population in a given space. Locusts raised in crowded cages invariably assume the colour and structural characters of the swarming phase, and those kept in isolation become typical of the solitary phase. The factor responsible for the transformation appears to be the greater activity on the part of locusts in crowded cages, where every movement of an individual disturbs the others and the mutual excitation practically never dies down. This excessive activity results in an abnormally high rate of metabolism, and the striking reddish (or yellow) and black coloration of the hoppers of the swarming phase may be ascribed to the deposition in the chitin of some products of this abnormal metabolism; these unknown products are called 'locustine' by Prof. Faure. Structural differences by which the two phases can be separated may be explained also as a result of greater development of certain muscles in gregarious hoppers as compared with the solitary ones. This theory was tested in a series of experiments in which hoppers kept in isolation were forced to excessive activity, but unfortunately this proved to be a very difficult task, since none of the several very ingenious methods of stimulation applied to hoppers produced the desired degree of activity. Nevertheless, the results show clearly that a change towards the gregarious phase occurs in isolated but active hoppers, and there remains little doubt that solitary hoppers if forced to lead an excessively active life would produce a locust of the swarming phase.

A supplementary factor of the transformation is temperature, since the gregarious phase is obtained more easily and is more typically developed at higher temperatures. This is also in keeping with the above theory, since the general activity of hoppers is greatly affected by temperature conditions.

The results of some experiments suggest that transformation is caused not only by direct environmental influence on the developing individual, but that the conditions of adult life may also have an effect on the characteristics of the progeny. Thus, the progeny of adults of the gregarious phase show certain characters of that phase already in the first instar; Prof. Faure suggests that this is not a case of the inheritance of phase characters, but that the phenomenon may be due to the 'locustine' being handed down to the progeny in the nutritive yolk of the eggs. Indeed, a series of crossing experiments proved that phase characters are not Mendelian characters, and disposed effectively of some earlier suggestions in that direction.

An interesting point is raised by Prof. Faure's experiments on the coloration of solitary hoppers. As a rule, such insects are rather variable in colour but often exhibit a close correlation with the colour of the surroundings. The breeding of hoppers in uniformly painted boxes resulted in many cases in excellent general imitation of the background, even of the white, or black one.

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* "The Phases of Locusts in South Africa". *Bull. Entom. Res.*, **23**, pt. 3, 1932, 112 pp., 25 pls., map.

These experiments throw an interesting light on the problem of the so-called sympathetic coloration in insects, and suggest a promising line of research. It was, however, somewhat unexpected that the green colour of environment is not imitated by hoppers, though they often become green on almost any background. Detailed experiments on the production of green coloration showed that it develops when hoppers are kept in a humid atmosphere and supplied with abundant moist food. However, attempts to discover chlorophyll in green hoppers failed, and the problem awaits further investigations.

Another interesting point raised with regard to the brown locust is the ability of its eggs to lie dormant for extremely long periods, up to 37 months after oviposition. A number of other equally interesting and important observations and experiments are recorded in the paper, which contains also a discussion of the bearing which these laboratory results have on the actual locust problem in the field. The knowledge of the phase transformation is already applied in practice in South Africa, and a careful watch for incipient congregations of solitary locusts in the field is kept. All such congregations are destroyed, with the result that the swarming phase has not appeared for several years. Further field ecological work will help in defining more precisely the areas favourable for the production of the swarming phase, and this will facilitate the anti-locust work still more, placing it entirely on the basis of prevention of outbreaks.

Prof. Faure's paper is exceptionally well documented by exact descriptions of experiments, tables of results and extremely well-reproduced coloured plates showing the remarkable range of the variation connected with the phase transformation of the species discussed. The results recorded constitute a great advance in our knowledge of the locust problem, and, moreover, they should go far towards demonstrating to biologists in general the outstanding interest of these insects, on which a number of fundamental problems can be studied better than on any other material.

B. P. UVAROV.

Obituary

PROF. JOHANNES SCHMIDT

THE science of oceanography has lost one of its most outstanding leaders by the death of Prof. Johannes Schmidt, director of the Carlsberg Physiological Laboratory, which occurred at Copenhagen on February 22 at the age of fifty-six years. His loss will leave a host of friends and colleagues all the world over with a sense of personal bereavement and regret, for being himself a great traveller with his home in Copenhagen, the headquarters of the International Council for the Exploration of the Sea, with which he was intimately associated, he was in close and frequent contact with all who were interested in the science of the sea. He was a man of quite exceptional charm, with a genius for friendship, always eager to help the work of others and to appreciate any help which others could give him in the execution of the bold schemes of research which he planned.

The name of Johannes Schmidt will no doubt be chiefly remembered for his solution of the age-old mystery of the life-story of the eel, but this success represented but a small part of his scientific activities and personal achievement. His versatility and breadth of view were striking. Starting his career as a botanist, his first expedition was to Siam in 1899, when he was editor and joint author of a report on "The Flora of Koh Chang". In 1910 he began at the Carlsberg Laboratory a series of investigations on hops (*Humulus lupulus* Linn.), publishing reports on their growth, biochemistry, and occurrence in the wild state in Denmark, and superintending researches on their fertilisation, development and the production of hybrids.

Later, under the inspiring influence of the late Dr. C. C. Joh. Petersen, and helped no doubt by his own enthusiasm for the sea—for first and last and always he was a good sailor-man—Schmidt became attached to the scientific staff which was carrying out Denmark's share of the programme of the International Council for the Exploration of the Sea. The importance of the fisheries at Iceland and the Faroes caused the Danish research vessels to go farther afield than those of the other powers, and the steam trawler *Thor* carried out regular cruises from Copenhagen to the northern waters of the Atlantic.

This was Schmidt's training ground for the extended expeditions in small vessels which he eventually undertook. At first he concentrated on the description of post-larval and early adult stages of fishes, especially of the cod family, and their distribution and migrations in relation to temperature and other physical characteristics of the sea-water. This was necessary pioneer work which has stood the test of time.

In May, 1904, Schmidt was collecting young fishes with large pelagic nets, and captured in the North Atlantic west of the Faroes one specimen of the *Leptocephalus brevirostris*, which Grassi and Calandruccio in 1896 had proved to be the larva of the common fresh-water eel. In the following year (1905) the *Thor* succeeded in capturing, at the end of May, a small number of specimens of *Leptocephalus* over the deep water off the west of Scotland, and still farther south the numbers increased over depths of 1,000–1,500 metres, until, in water of this depth in the central part of the plateau off the mouth of the English Channel, up to 70 per two hours' haul were obtained with nets towed with about 300 metres of wire. A few hauls taken in September, west of the Hebrides, showed that the larvæ were already beginning to metamorphose, and would soon completely change into elvers or glass-eels.

To determine where the eels actually spawned it remained to find the earliest larval stages and the eggs. This involved a search extending all over the whole southern and western part of the North Atlantic. Only after years of persistent effort was it possible to reach a full and satisfactory solution of this aspect of the problem. Successful cruises were made in the *Thor* to the Straits of Gibraltar and the Mediterranean (1908–10). Arrangements were made with Danish ship-owners for nets to be towed from steamers crossing the Atlantic by different routes. In 1913 a small sailing schooner, the *Margrethe*, was equipped and cruised in the Atlantic as far as the West Indies, when it was found that the smallest sizes of the larvæ were all taken west of a line drawn from Newfoundland in a south-easterly direction towards Cape Verde. In 1920 a large schooner, the *Dana*, replaced the *Margrethe*, which had been wrecked. After two years it became possible to map out the breeding grounds by a study of the distribution of the earliest larval stages, less than 10 mm. in length, which had all been taken in a comparatively small area, the centre of which lay midway between the Leeward Islands in the West Indies and Bermuda. By these researches Schmidt may be said to have solved the main problem of the life-history of the eel.

With this extension of his cruises into the Atlantic Ocean, the scope of Schmidt's oceanographical work became enormously enlarged, and had developed into an important study of the great oceans. The Danish Government secured a large steam trawler, also named *Dana*, and equipped her as a research vessel. In this ship he undertook a number of voyages in the Atlantic Ocean, the Pacific and the Mediterranean, and finally made the great two years' voyage around the world in 1928–30, an account of which he published in NATURE of March 21 and 28, 1931.

Schmidt's study of the geographical distribution and life-histories of fishes led him, at an early date, into researches on fundamental biological problems concerning the nature of species, of races and of heredity, and his success as a biometrician and as a student of genetics was almost as striking as that which he achieved in oceanography. Biometrical studies on races of fish had formed a feature of his early work on gadoids and eels. Later, in a series of papers published between 1917 and 1922 in the *Comptes-Rendus* of the Carlsberg Laboratory and in the *Journal of Genetics*, the subject was developed on both statistical and experimental lines. Striking results were obtained with the viviparous blenny (*Zoarces*). He was able to show that in some of the Danish fiords the average number of vertebræ in populations of this fish living at the upper ends of the estuaries is significantly lower than that of the populations in the estuary mouths, the latter again being lower than that of populations living outside in the Kattegat. The averages varied progressively from 108·0 to 117·3. The question whether these fluctuations were due to heredity or to environment, or to both these factors, was made the subject of a well devised series of experiments. A comparison of the average number of vertebræ in 857 mothers, with the corresponding number in 8,570 individuals of their offspring, showed that the values for the offspring continuously increased as the maternal numbers increased from 107 to 119. The conclusion was drawn that such a conformity could not appear if the number of vertebræ in an individual were determined by the environmental conditions existing during development alone. The number of vertebræ must therefore be, in part at any rate, a hereditary character. Experiments were then made by keeping samples of 300 specimens of each of two different populations of *Zoarces* in an enclosed area near the mouth of Ise Fiord in large, perforated wooden boxes, with the result that the difference in the numbers of vertebræ in the two populations did not disappear in the offspring. On the other hand, two samples of the same population, allowed to develop under different environmental conditions, did show a smaller, but significant difference in the number of vertebræ of the offspring.

In continuation of work on race problems, Schmidt carried out many breeding experiments on trout, and on the fresh-water tropical fish *Lebistes reticulatus*, as well as on poultry.

Such a wide and varied field of fruitful effort leads one to ask, what qualities in the man lay at the root of his success ? First, I think, a broad, clear outlook on the problems he hoped to solve was followed by a bold but simple and straightforward plan of attack : then, steady, hard, persistent work, carried on year after year with no turning aside, every detail carefully thought out, every operation accurately performed until at last the answer came. He was a fine organiser and knew how to get the best from those who helped him. The brilliant school of young marine biologists in Denmark, who will continue the work that he began, is his true memorial.

E. J. ALLEN.

DR. ALFRED RÉE

IN the death of Dr. Alfred Rée at Withington on February 26, at the age of seventy years, both chemical industry and the profession of science lose an acknowledged leader and one whose wide outlook and sympathy had won universal respect. Dr. Rée was born at Leeds and educated at the Bradford Grammar School and later at the Universities of Geneva and Munich. He was a Doctor of Philosophy of the University of Berne and had travelled widely on the Continent and in the United States, to which circumstance no doubt his interest in international affairs was partly due. He was a warm supporter of Lord Derby when he was forming the English

Speaking Union and many Americans found a genuine welcome at Dr. Rée's house.

Dr. Rée entered business as a dyestuffs manufacturer and was proud of a connexion through Claus Rée and Co. at Clayton with Brooke, Simpson and Spiller, who were successors of Simpson, Maule and Nicholson, and Perkin and Sons, the original manufacturers of mauve. Although he retired from the industry in 1907, he retained many and varied interests in dyestuffs and other branches of chemical industry and was a director for some years of the British Dyestuffs Corporation. He is probably best known for his work for the Manchester Chamber of Commerce; early in his life he was vice-chairman of the chemical section and he played a prominent part in securing reform of the patent laws. Elected a director of the Chamber in 1910, he was made president in 1924–25. He was one of the founders of the Association of British Chemical Manufacturers and served on its Council for several years, being still an honorary member at the time of his death.

With these industrial and commercial interests, Dr. Rée combined a keen interest in education and long served the University of Manchester as treasurer and deputy treasurer. He was for many years chairman of the chemical section of the College of Technology and served on the Manchester Education Committee from 1910 until his death. He was elected a fellow of the Institute of Chemistry in 1918 and served on its Council in 1927–30. He took an active interest in the formation of the British Association of Chemists in 1917 and served as its first chairman. He was one of the oldest members of the Society of Chemical Industry and was a vice-president in 1919–21. He also served as president of the Society of Dyers and Colourists in 1916–17 and his presidential address to that Society is a fine example of his wide outlook and mature judgment.

Few scientific workers have indeed displayed such a fine capacity for public as well as personal service and only Dr. Rée's modesty prevented him from being better known. He was singularly free from ambition and was a most approachable man in spite of his many interests. A quiet but tenacious personality and a rare capacity for impartial judgment won him wide popularity as well as respect, and his indefatigable industry leaves a place among the country's industrial and professional leaders which will be hard to fill.

R. B.

Sir Benjamin Gott

Sir Benjamin Gott, who died on February 26 at the age of sixty-seven years, was one of the group of distinguished educational administrators whose careers virtually began with the passing of the Education Act, 1902. Sir Benjamin held the office of Secretary to the Middlesex Education Committee from 1902 until 1928; he was appointed Organising Inspector of Technical Education in Middlesex in 1898, and, at the date of his retirement, had completed thirty years' service as Education Officer to the Middlesex County Council.

Benjamin Scaife Gott was born at Bingley and became a foundation scholar of Bradford Grammar School. Thence he passed as a scholar to Gonville and Caius College, Cambridge, where he took a first class in Part I and a second class in Part II of the Natural Sciences Tripos. After three years on the staff of Wesley College (now King Edward VII School), Sheffield, he became science master at Cheltenham Grammar School, where he had Sir Robert Blair, afterwards Education Officer to the London County Council, and Mr. E. Salter Davies, Director of Education for Kent, as colleagues. He also acted as Principal of the Cheltenham School of Science.

His duties in Middlesex were at first confined to technical education—the opportunity for the full exercise of his great gifts as an administrator came with the Education Act, 1902, by which the County Council became the higher education authority for the whole of the Administrative County and the elementary education authority for an area containing about one-third of its population. It was Sir Benjamin's ambition to create a system of secondary schools which would make higher education available for all boys and girls of ability, however poor the circumstances of their parents. He had the satisfaction of seeing his ambition realised before he retired. In the interval between 1902 and 1928, the County Council had provided thirty-four new secondary schools and the number of pupils in attendance had increased from 700 to 18,000. In 1898 the Middlesex authority spent £7,000 on education; in the last year of his service, the authority's expenditure was nearly £1,500,000.

Sir Benjamin was, for some time, a member of the Consultative Committee of the Board of Education, the Adult Education Committee, and the Burnham Secondary and Technical Committees. After the War he rendered valuable service as Divisional Director of Industrial Training in connexion with the Ministry of Labour's scheme for the training of disabled ex-Service men. In 1924 he received the honour of knighthood in recognition of his services to education.

Soon after he retired, Sir Benjamin became chairman of the Commission on Educational and Cultural Films. A few weeks before his death he accepted the chairmanship of the Unemployment Committee of the National Council of Social Service, and in order to free himself for the onerous duties of this position, he resigned his membership of the governing bodies of the Northern Polytechnic, University College School and the Maria Grey Training College. This work took him to Bolton the day before he died. Whilst presiding at a conference of voluntary workers, he was overcome by a fainting attack, which was followed by a fatal seizure early the next morning.

MR. W. McWHIRTER

MR. W. McWHIRTER, who died at Glasgow on March 6, at the age of eighty-two years, was one of the pioneers of the electrical industry. In 1882 he invented the first instruments for indicating volts and amperes and these he continually developed, introducing magnetic shielding and other devices into his ammeters and voltmeters. His electrical water-level indicators and recorders fulfilled a most useful function.

Apprenticed to his uncle in the bakery and confectionery business, McWhirter spent nearly all his leisure experimenting on magnetism and electricity. He joined the Glasgow and South Western Railway, where he attained the position of divisional inspector. He then joined the Barrow and Furness Railway and was partly responsible for one of the earliest installations of dock lighting by means of arc lamps at Barrow. He was also responsible for the first electric lighting installation at the Glasgow Central Station. In those days the arcs were not well shaded, so that the light was dazzling and cast such dark shadows that one had to walk warily. After lighting the Central Station, McWhirter started business in Glasgow and, later on, opened the Faraday Electrical Engineering Works in Govan, where important improvements were made in the efficiency and commutation of the dynamo.

Mr. McWhirter was well known to all the older generation of electrical engineers and had many friends. He was one of the founders of the Electrical Contractors' Association in Scotland and was chairman of the Scottish centre of the Institution of Electrical Engineers in 1912. In the course of his electrical researches he co-operated with Silvanus Thompson, Ayrton and Perry. One of his pupils was Dr. A. Hay, who was a professor at Coopers Hill and afterwards at the Indian Institute of Science, Bangalore.

WE regret to announce the following deaths:

The Duke of the Abruzzi, Founder's medallist of the Royal Geographical Society in 1901, who was known for his explorations in the Far North, in Africa and in India, on March 18, aged sixty years.

Prof. W. C. Unwin, F.R.S., emeritus professor of engineering in the Central Technical College, City and Guilds of London Institute, president of Section G (Engineering) of the British Association in 1892, of the Institution of Civil Engineers in 1911, and of the Institution of Mechanical Engineers, on March 17, aged ninety-four years.

News and Views

Early Man in East Africa

ON March 18–19 a conference summoned by the Royal Anthropological Institute met at St. John's College, Cambridge, under the presidency of Sir Arthur Smith Woodward, to receive reports on the human skeletal remains discovered by Dr. Leakey's archæological expedition to East Africa in the autumn of last year. On the geological, palæontological, archæological and anatomical evidence, the findings of the respective committees are :—(1) That it is clear that the two fragments said to have been found *in situ* at Kanjera belong to the original deposit and that the fragments cannot have been introduced into the calcareous deposits at a later date ; (2) that the fragment of human lower jawbone from Kanam is derived from a deposit of lower Pleistocene age, while the fauna from the Kanjera deposits, in which the cranial fragments were found, cannot be later than the middle Pleistocene ; (3) that the cranial remains from Kanjera show no character inconsistent with reference to the type of *Homo sapiens*, special points noted being the absence of any frontal torus and a thickness of bone not present in any non-pathological modern skull and comparable with that of the Piltdown and Boskop skulls : while the Kanam jaw shows no appearance incompatible with its inclusion in the type of *Homo sapiens* or with the high antiquity assigned to it ; and (4) that the Kanam jaw is associated with a pebble industry, comparable to Oldoway Bed I, which has no precise counterpart in western Europe ; and the Kanjera skull with a Chellean industry corresponding with that of the upper part of Oldoway Bed II, the pebble industry of Bed I being older than the Chellean industry from Bed II, while the latter corresponds typologically to industries from deposits of early Pleistocene age in Europe.

Indian Federation

WITH the publication of the White Paper, discussion of the future government of India enters on its final phase. At this stage it would be vain to expect that any fundamental change will be made in the basic principles upon which the proposed constitution has been framed. For good or for ill, a matter on which time alone will give a ruling, the principles of Western democracy, which themselves in the West are now being strained to breaking point, will be applied to an Eastern community, or rather communities, in which the elements, especially that of Hinduism, as past experience has shown, are further removed in temperament from the spirit of compromise, which is of the essence of democracy, than almost any other community in the world. Hinduism as a social and religious system has shown in the past an almost unlimited power of assimilating elements from outside, but it is itself incapable of adaptation. Even the influence of Mr. Gandhi has not availed to modify the position of the Untouchables, notwithstanding the political gain that thereby would have accrued to Hinduism. However flattering the abortive results of Mr. Gandhi's efforts to the opinion of the scientific observer, he regretfully accepts this as further confirmation of his view that native institutions alone, and not the restricted individual franchise, could attain in India the desired end of government by consent of the whole people.

Metropolitan-Vickers Representatives in Russia

AT our request, the Metropolitan-Vickers Electrical Co., Ltd., has been good enough to send us the following particulars of its technical representatives, whose recent arrests in Russia have been the subject of a number of questions in Parliament: Mr. Allan Monkhouse, M.I.E.E., A.M.I.Mech.E., who is at present manager in Russia for Metropolitan-Vickers Electrical Export Co., was for several years a senior member of the staff of the Research Department, devoting his interest more particularly during those years to problems on insulation. In addition to his contributions to the scientific press, Mr. Monkhouse wrote "Electrical Insulating Materials" published in 1926. Mr. L. C. Thornton, A.M.I.E.E., left Trafford Park in 1924 to go out to Russia on erection work for Metropolitan-Vickers and has for a number of years been in charge of all erection work in Russia. Mr. J. Cushny, B.Sc.(Eng.), A.M.I.C.E., A.M.I.Mech.E., served his apprenticeship with Metropolitan-Vickers and after serving on the erection staff in Russia for some years, was appointed senior assistant to Mr. Thornton. Messrs. W. L. MacDonald, A. W. Gregory and C. H. de Nordwall, all of whom joined the firm between 1920 and 1922, have been engaged in erection work in Russia for some considerable time. The Metropolitan-Vickers Export Co. has now been supplying plant and machinery to the U.S.S.R. for the last ten years. For the latter part of this time it has had, in addition, an agreement under which technical information and supervision has been supplied by the Company to the U.S.S.R. which has been building the Company's turbines under licence. This agreement is one of the results of the leading position in the field of turbine engineering occupied by the Company, and the agreement has for the last few years been extended to cover the design and manufacture of heavy electrical plant.

Aeronautics and the Royal Air Force

SIR PHILIP SASSOON, M.P., Under Secretary of State for Air, in his air estimates speech in Parliament on March 14 offered a good deal of congratulation to the technical and scientific side of the aeronautical community in Great Britain, in that it has managed to maintain progress and extended activities in spite of a progressive reduction in its expenditures. Special tribute was paid to Sir Richard Glazebrook, who retires at the end of this month from the chairmanship of the Aeronautical Research Committee, where he will be succeeded by Mr. H. T. Tizard, rector of the Imperial College of Science and Technology. Sir Richard has been associated with the scientific side of aeronautics since 1909, and has been chairman of the Aeronautical Research Committee since its formation thirteen years ago. Speaking of the Royal Air Force, Sir Philip said that no new squadrons are being formed, although it is still ten short of the 1923 approved programme, and is closing one flying training school. In spite of reductions it has rendered both direct and indirect assistance to the administration of law and order in the more backward of the Empire territories overseas. The suppression of turbulent tribes, transporting of British troops to stiffen up disaffected native levies, giving flights to political agents and local chiefs in areas in which the inhabitants still held that aircraft were a myth, making a flight over the Himalaya range in 2 hours 20 minutes, which normally needed a 17 day march, are among the direct activities mentioned.

THE humanitarian and less directly productive work carried out by the Royal Air Force during the past year is equally striking. Supply of medical services, flood warnings, surveying, fishery protection, locust fighting, famine relief, mail carrying to isolated communities, have absorbed as much as 40 per cent of the flying time of some of the Middle East squadrons. The making of record flights, such as the recent long distance to the Cape, which now brings the records for speed, height, and distance to British aeronautics, is not without its indirect value to Great Britain's prestige. A new system of subdivision of duties amongst R.A.F. mechanics will make considerable saving in the cost of personnel without affecting the technical efficiency of the aircraft maintenance. This is due to the complete change over to all-metal aircraft. Dealing with civil aviation, Sir Philip referred to the continued expansion of Imperial Airways and promised the Indian extension of the Australian air route during 1933. Air passenger traffic has increased by more than 100 per cent on European, and more than 50 per cent on other Empire, routes.

The Panda at the Zoological Gardens

THE carnivores are really a very remarkable group, ranging in size from the tiger to the weasel, and presenting singular contrasts in the matter of shape. Nor are they all flesh-eaters, some being almost exclusively vegetarians, and one, the kinkajou, has developed a prehensile tongue, like an ant-eater, and a prehensile tail like a spider-monkey. The shape of the body has been moulded by adjustment to their feeding habits. Some have become burrowers, some arboreal, and some aquatic. Their coloration has in like manner been governed by this same factor of food-hunting which of course determines their environment, as witness the polar bear, the tiger, the leopard, and the Cape hunting dog. But there are many other and less familiar types of coloration. Among these is the singular panda (*Aelurus fulgens*), a recent arrival at the Zoological Gardens, Regent's Park. It is a creature which cannot fail to attract the attention of visitors owing to its striking coloration. A native of the south-eastern Himalayas, where it lives among rocks and trees at a height of 7,000-12,000 ft., its habits, and the relation thereto of its coloration, have never been the subject of careful observation. Placed under relatively natural surroundings—which is becoming more and more a distinctive feature of the Gardens—some useful information may be gleaned on this head.

As touching the coloration of the panda in relation to its haunts, we have little to build on at the moment, for while some tell us it is found among the rocks, others tell us that it is arboreal. Probably it affects both environments as circumstances may determine. The racoons, to which tribe it belongs, display a similar versatility. The general hue of the upper part of the body is of a lively chestnut-red, with white markings on the face, while the legs and belly are black. The tail, nearly as long as the body, displays the rings characteristic of the racoon. Since it is largely a vegetarian, with a fondness for fruit, this coloration must be regarded as protective: and it may bear some relation to the positions assumed during sleep when protection of this kind is most needed. But here again we are in need of further observation; for it is said to sleep coiled up like a cat with the bushy tail over its head, but at other times resting on its haunches with the head tucked under the chest, and between the fore-legs, after the manner said to be common with the racoons. Here, surely, is a matter which can be settled at the Gardens.

Photoelectric Exhibition at the Science Museum

A SPECIAL exhibition devoted to photoelectric cells and their practical applications will be opened at the Science Museum, South Kensington, on March 25, and will remain on view for three months. Photoelectric cells are now being widely applied both in pure science and in industry, and the exhibition is intended to give an illustration of the great variety of these applications. Besides exhibits showing the construction of the three main types of light-sensitive cell, some simple working experiments have been arranged to demonstrate their properties and to illustrate some of the methods of amplifying the small currents yielded by the cells under varying illuminations. The practical applications of photoelectric cells can be roughly classified into those involving only the detection of light and those involving its measurement. The first class is illustrated in the exhibition by a number of working models showing the use of the cells, for example, for counting small packages on a conveyor belt, and in burglar alarms, while, as an illustration of the way in which a comparatively large amount of power can be controlled, there is a door which is automatically opened whenever a certain beam of light is interrupted by the visitor. Applications involving the measurement of light intensity are also illustrated. These include the measurement of daylight or of indoor lighting, the automatic switching of street-lamps, and the measurement of the density of factory smoke, while the ability of photoelectric cells to respond to rapidly fluctuating light is shown by their well-known applications in the reproduction of sound from sound-films, and their use in television.

Early American Bridges

AT a meeting of the Newcomen Society held at the Caxton Hall, Westminster, on March 15, Capt. L. N. Edwards, of the United States Bureau of Roads, read a paper on "The Evolution of Early American Bridges" in which he dealt with the work of the bridge pioneers of America down to the time of the Civil War of 1861–65. All the early settlements, he said, were situated on sheltered bays, tidal inlets or navigable streams and "the water was the first American highway". When roads came to be constructed, it was natural that the necessary bridges should be simply tree trunks felled at the site. Transportation developments were a challenge to those engaged in bridge building and the art of carpentry became of immense importance. In the eighteenth century, pile and trestle bridges came into use and these were followed by arched and trussed structures, some of great span. The Upper Ferry Bridge over the Schuylkill River built by Louis Wernag in 1812 had a wooden arch of 340 ft. span and the McCalls Ferry Bridge over the Susquehana River built by Theodore Burr in 1814 had a central span of 364 ft. Especially important were the trusses patented by Ithiel Town, 1820, Col. S. H. Long, 1830, William Howe, 1840 and the two Pratts, 1844. A wrought-iron chain suspension bridge was built by James Finley in 1801, while in 1842 Col. Charles Ellet built the first wire suspension bridge in America. Cast iron was successfully used for a bridge in 1836. Sixty-seven patents for bridges were issued by the United States Patent Office between 1797 and 1860. The first books on bridge work were by Herman Haupt, 1842, and Squire Whipple, 1847. Capt. Edwards's paper, which was illustrated with many lantern slides, is a notable addition to the history of the subject of American bridges.

Cosmic Radiation

IN his Symons Memorial Lecture delivered before the Royal Meteorological Society on March 15, Mr. P. M. S. Blackett dealt with "Cosmic Radiation". The study of what is now known as cosmic or penetrating radiation began more than thirty years ago with the experimental investigation of the conductivity of the air in closed vessels. By 1932, measurements of the ionisation had been carried out up to heights of 28 km. in the atmosphere and down to depths of 230 m. under water. The ionisation is found to be 100,000 times more intense at the highest point reached compared with that at the greatest depth. More than four hundred papers have been written on the subject and still the nature of the primary radiation is not certain and its origin quite unknown. The ionisation is constant in time to within two per cent at any one place, but is about twelve per cent less intense at the equator than in latitudes of 50° N. and S. From these latitudes to the poles it is nearly constant. It is probable, but not certain, that the primary radiation incident on the earth's atmosphere consists of an isotropic corpuscular radiation with a mean energy of more than 10^{10} volts. The actual ionisation at sea level is due to fast particles, mainly electrons, protons and 'positive electrons'. The tracks of these particles can be photographed by the cloud method and such photographs have shown that very complex phenomena of great variety and interest occur in connexion with the absorption of the primary cosmic rays by matter.

Museums of British Territory in Africa and the Mediterranean

HARD on the heels of the report on Canadian museums by Sir Henry Miers and Mr. S. F. Markham, which was reviewed in NATURE of January 21, p. 84, comes the same authors' "Report on the Museums and Art Galleries of British Africa" together with a "Report on the Museums of Malta, Cyprus and Gibraltar by Alderman Chas. Squire and D. W. Herdman". The report is accompanied by a "Directory" (price 5*s.*) of all these museums, and of those of Mauritius, constituting the third volume of the "Directory of Museums" being published by the Museums Association. To visit the forty museums of Africa was a strenuous enterprise even with all the resources of modern transport. Those museums cover a wide range in quality and administration as well as in distribution, from the fine South African Museum in Cape Town to the poor apology for a scientific museum, which, as the authors say more than once, is unworthy of that rich city Johannesburg. Poverty coupled with handsome buildings are the characteristics of the South African museums—a combination not unknown in other lands. Their chief needs are said to be "greater financial security, some forms of active co-operation between all museums, and the development of educational work".

THE museums of the East African and West African territories are barely out of the shell, so that the reporters can do little more than tender good advice. The Coryndon Museum at Nairobi and the Zanzibar Museum are the only institutions worthy to be called public museums. Over areas to be measured in millions of miles, museums are needed to fulfil what is still the first purpose of a museum—the preservation of objects that would otherwise be lost, and nowhere is civilisation more destructive than in Africa. The Mediterranean museums present different problems, but here too it is this primary function that comes first in the report, as shown by its insistence on permanent curators, a higher standard of curatorship, protection against fire, and cases that will keep out dust and insects. The value of these reports to the museums concerned, and the usefulness of the directories to those elsewhere, can scarcely be exaggerated. That on Canada is already fruitful of results; though its criticism was severe, its expression was tactful and it has aroused no resentment but rather a determination to profit by it. Great credit and warm thanks are due to the Museums Association which does the work and to the Carnegie Corporation which provides the funds.

Measurement of Chimney Smoke

MAJOR C. E. PRINCE gave an interesting lecture to the Junior Institution of Engineers on February 24 on the practical applications of light-sensitive apparatus. The effects produced by a beam of light when projected on vapours, the particles of which, like drops of water, are possessed of reflective and refractive powers, have to be studied. The most useful effect for observation is the deflection or scattering of the beam. In the case of smoke, the interruption of the light by the particles of carbon gives the easiest and best method of measurement. Major Prince showed apparatus in which a beam projected through smoke and then on to a light-sensitive element gave a continuous quantitative record on a moving chart of the diminution of light due to the smoke. One difficulty was to interpret the readings in terms of a definite unit as the cut-off varies with the depth of the column penetrated by the light. The problem is of importance as it gives a method by using indicating or recording instruments for proving or refuting a contention that excessive smoke was being or had been allowed to issue from industrial chimneys. The present method of visual observation and comparison with a Ringelmann screen at the chimney top takes little or no account of the size of the chimney and consequently of the volume apart from the density of the issuing smoke. It neglects also the direction of the wind and its effect upon the apparent density of the smoke. It is necessary to define more accurately the density of smoke at a given distance. By using a selenium or a photoelectric cell, this is possible. It remains for those who have the managing of smoke-producing units and those who apply the regulations governing smoke nuisance to agree on a standard method.

National Institute of Agricultural Botany

ONE of the ways in which the Government in Great Britain is aiding agriculture is through grants made to the National Institute of Agricultural Botany. This Institute is doing very important work for the farming community by testing seeds and by encouraging the use of better varieties of plants. The thirteenth annual report, which has just been published, states that the record number of 30,680 samples of seeds was tested in the year ended July 31, 1932, at the Official Seed-testing Station. Trials with oats showed that one variety, Golden Rain II, gave the best results, although it is not widely grown; and that in Wales the variety popularly believed to be the best (Record) was significantly inferior to the three other varieties tested. The outstanding problem in the home beet-sugar industry is to improve the yields of beet and of sugar per acre; whereas the average for Europe is about 1½ tons of sugar per acre, in Great Britain it is only slightly more than 1 ton. The Institute has been attacking this important problem and has demonstrated how much these yields depend upon the variety grown. Trials extending over three years have shown differences of nearly 20 per cent between varieties in use by farmers, and Kleinwanzleben *E* has in general been found to be by far the best; at one centre it gave no less than 3 tons of sugar per acre. As a result of this work, it is now possible to recommend twelve different strains for use in the British Isles. Other activities of the Institute include the provision of pure stocks of cereal seed, the improvement of varieties of potato in respect of yield, and, especially, of immunity from disease, and the prevention of the use of more than one name for the same variety.

Minimum Climatic Temperature

A RECENT note by C. F. Talman of the United States Weather Bureau, one of the "Why the Weather?" series issued by Science Service, Washington, D.C., describes an observation of some interest for those who attach importance to climatic extremes. The note states that when Archdeacon Stuck climbed Mount McKinley, Alaska, in 1913, he placed a minimum thermometer in a small wooden case and fastened it securely in a cleft of rock at a height of 15,000 feet above sea level. When the thermometer was recovered last May, it was found that the index was down in the bulb, and indicated a minimum at least as low as −100° F. Mr. Talman finds it difficult to say how much confidence can be placed in the observation; one possibility suggested is that vibration due to strong wind caused the index to fall below what should have been its lowest position. According to the 1930 edition of the "Meteorological Glossary" of the Meteorological Office, Air Ministry, the lowest temperature recorded at the earth's surface is −93·6° F. at Verkhoïansk, Siberia, on January 3, 1885. There is now at least one colder place in Siberia than Verkhoïansk equipped as a climatological station; such a place would probably have yielded a lower reading than −93·6° had it been in operation in 1885. In the free air, much lower readings have been recorded at greater heights in low latitudes, where the normal fall of temperature with height is maintained to such high levels that in spite of the relative warmth near the ground a lower temperature is recorded than at any height in temperate or high latitudes. The "Meteorological Glossary", for example, refers to a reading of −131·6° F. obtained at a height of about 54,000 feet above Batavia, Java.

Archæology and Tradition

THE Sir John Rhys memorial lectures of the British Academy, inaugurated in 1925 and delivered annually since that date, have now secured, as a series, a place in Celtic studies worthy of the great scholar they commemorate. The lectures have been apposite in subject and the lecturers have never failed to stimulate interest in their special field. The latest lecture to be published (London: Oxford University Press. 1*s*. 6*d*. net), by Prof. H. Fleure on "Archæology and Folk-Tradition", deals with a matter of interest to both archæologist and folklorist, but perhaps at the present stage in archæological studies, more particularly to the former. The illustration, or perhaps illumination, of conclusions derived from archæological data by reference to tradition and legend may become an alluring, but somewhat hazardous, exercise in ingenuity. Prof. Fleure's suggested relation of "The Twilight of the Gods" to a period of climatic deterioration and racial unrest in bronze age Europe is suggestive, but at the same time by its very restraint inculcates caution in those who have not his wide knowledge of the archæological aspects of ancillary sciences such as meteorology, botany, and geography, which is essential for a synthesis such as he essays. Turning more specifically to Britain and the relation of British and Irish archæology to Celtic tradition, his interpretation, for example, of Irish ethnic tradition shows by precept and example how at each stage the argument must adhere rigidly to ascertained fact. Yet notwithstanding his caution, Prof. Fleure feels able to place some reliance on the traditional Spanish connexion of early Irish peoples and incidentally to offer an enlightening suggestion as to the possible origin of the obscure Tuatha de Danann.

Submarine Telephone Cables at Carrier Frequencies

IN ordinary telephony the sound waves falling on the microphone vary the pressure on the carbon granules through which a current is flowing. The resistance of the circuit thus varies, and so the current varies with the sound wave and in the receiver produces sound waves exactly similar to the original waves. In radio-telephony, in place of the current in the connecting wires, we have a high-frequency current emitted from the transmitter. This is varied (modulated) by the sound waves. These modulated waves falling on a suitable receiver reproduce waves similar to the original sound waves. Better results are obtained by using conducting wires, and in particular submarine cables. The cost of the cable in this case makes it necessary that it should carry pairs of wires providing several channels of communication. The disadvantage of this type of cable is the great difficulty of laying and maintaining it in deep water. For deep sea work a single core cable is used provided with a copper sheath under the armouring to carry the return current. In 1920 the serious single-channel limitation of this type of cable was overcome by the use of carrier wave high frequencies. This enabled telephone cables to be laid and operated between Key West (Florida) and Havana, a distance of 103 nautical miles. In a paper read to the Institution of Electrical Engineers on February 23, Dr. E. W. Smith discusses the electrical requirements for this type of transmission. He also summarises the most recent advances in materials and methods of construction and indicates probable future developments.

A Modern Granary

WHAT is described as the largest granary in South America, and in equipment, probably the most complete in the world, is described in *Engineering* for February 10 and 24 and March 10. The granary has recently been erected by the Buenos Aires Great Southern Railway at the port of Bahia Blanca, Argentina, at a cost of about £1,000,000. The plant consists of an unloading station for the discharge of grain from the railway wagons, a ferroconcrete granary of 80,000 tons capacity, a loading jetty and shipping galleries. For the transport of the grain there are no fewer than 120 conveyors having more than twelve miles of conveyor and elevator belting. The whole plant is driven electrically, current being supplied from a sub-station to some 240 electric motors of an aggregate horse power of about 10,000. Some idea of the capacity of the plant can be obtained from the statement that, while grain can be unloaded continuously at the rate of 1,000 tons an hour, on the outgoing side six ocean-going ships can each be loaded simultaneously at the same rate. Each year Great Britain imports about 1,000,000 tons of wheat from the Argentine, and it is a matter for satisfaction that the main contract for the buildings, plant and equipment of this notable granary amounting to about £800,000 has been carried out by Messrs. Henry Simon Ltd., of Manchester, at which place the machinery and equipment were assembled before shipment to South America.

Aluminium in Food-Stuffs

ATTENTION has been directed of late to the effects of, and possibility of poisoning from, aluminium derived from food-containers and cooking utensils. In view of the importance of the subject, the Mellon Institute of Industrial Research, Pittsburg, Pennsylvania, has instituted a critical search of the scientific literature relating to the chemistry and pharmacology of aluminium, and has now published "A Select Annotated Bibliography on the Hygienic Aspects of Aluminium and Aluminium Utensils", giving the scope, with critical notes, of the papers consulted (Bibliographic Series, Bull. No. 3). Dr. Beal, assistant director of Mellon Institute, contributes an introduction in which he concludes that aluminium is not a poisonous metal and does not give rise to any disease, that aluminium utensils are very resistant to corrosion by food-stuffs cooked therein, and that aluminium does not accelerate the destruction of vitamin or other food accessory substances during cooking.

Announcements

THE Right Hon. Lord Stonehaven has accepted nomination as president of the Institution of Naval Architects in succession to Admiral of the Fleet, Lord Wester Wemyss. The election of the new president will take place at the opening meeting to be held at the Royal Society of Arts on April 5.

DR. J. T. DUNN has been elected president of the Society of Chemical Industry for 1933–34, in succession to Dr. R. H. Pickard. Dr. Dunn was appointed headmaster of Gateshead School in 1886, and then head of the Plymouth Technical School in 1894. Later he became the first principal of the Northern Polytechnic, Holloway. He is now the public analyst of Northumberland, and in 1930–32 was president of the Society of Public Analysts.

THE gold medal of the Institution of Mining and Metallurgy has been awarded to Sir John Cadman, in recognition of his work in the advancement of technical education and the development of the mineral industries; and of his distinguished public services. The following awards have also been made: Consolidated Gold Fields of South Africa, Ltd., gold medal to Mr. C. A. Banks for a paper on "Air-Transportation of Gold Dredges in New Guinea"; Consolidated Gold Fields of South Africa, Ltd., premium of forty guineas conjointly to Mr. J. L. Francis and Mr. J. C. Allan for their paper on "Driving a Mines Drainage Tunnel in North Wales"; William Frecheville student's prize of ten guineas to Mr. G. J. Williams for a paper on "The Genesis of the Perrunal—La Zarza Pyritic Orebody, Spain".

AT the annual general meeting of the Geological Society of London held on February 17, the following officers were elected for the ensuing year: *President*, Sir Thomas Holland; *Vice-Presidents*, Prof. E. J. Garwood, Mr. J. F. N. Green, Mr. W. Campbell Smith, and Prof. W. W. Watts; *Secretaries*, Prof. W. T. Gordon and Prof. P. G. H. Boswell; *Foreign Secretary*, Sir Arthur Smith Woodward; *Treasurer*, Mr. F. N. Ashcroft.

UNDER the terms of the Thomas Gray Memorial Trust, the Royal Society of Arts is offering a prize of £100 for an improvement in connexion with the science or practice of navigation, invented in 1932 or 1933; also a prize of £100 for an essay on fire at sea. Further particulars can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, W.C.2.

PROF. B. W. HOLMAN, honorary general secretary of the Association of Scientific Workers, 70 Victoria Street, London, S.W.1, informs us that the Association is engaged in compiling a handbook of "Extra-University Research in Pure and Applied Science", in which it is proposed to give data concerning commercial, endowed, and private laboratories not included in the "Universities Yearbook". It is not intended to include laboratories and other institutions devoted solely to testing materials and products, collecting data and other work not of a developmental and original character. Firms and others who are engaged in research are invited to communicate with the Association.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mathematics and science as applied to the building industry at the Northern Polytechnic, Holloway, London, N.7—The Clerk (March 31). An assistant to the City Analyst under the Leeds Corporation—The Medical Officer of Health, 12, Market Buildings, Vicar Lane, Leeds, 1 (April 3). A woman lecturer in mathematics and elementary science at the Municipal Training College, Cottingham Road, Hull—The Principal (April 5). A demonstrator in physiology and dietetics at King's College of Household and Social Science (University of London), Campden Hill Road, W.8—The Secretary (April 13). An engineer-manager for the States of Guernsey Electricity Department—The President, Appointments Board, Royal Court, Guernsey (April 15). A senior assistant in the Nautical Almanac Office—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (April 20). A professor of pathology at the University of Bristol—The Secretary and Registrar (April 20). A lecturer in civil engineering at the University of Leeds—The Registrar (April 22). A professor of mental and moral philosophy at the University of Otago, Dunedin, New Zealand—The High Commissioner for New Zealand, 415, Strand, W.C.2.

ERRATUM.—In NATURE of March 18, p. 385, col. 1, line 26, for "*Odonatra zibethica*" read "*Ondatra zibethica*".

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Nuclear Energy Levels

It is a plausible hypothesis that the forces acting on a particle inside the nucleus are comparatively weak in the internal region and increase rapidly to the boundary of the nucleus, the potential distribution being represented by a hole with more or less flat bottom and rather steep walls[1]. If we approximate this model by a rectangular hole with infinitely high walls, the energy levels of a moving particle will be determined by the roots of Bessel functions and can be easily calculated. For the real model, however, this theoretical level system will be deformed owing to the fact that the walls are neither quite steep nor infinitely high, producing compression of the upper part of the level system.

The best nucleus for testing this hypothesis is that of radium C′, for which a lot of experimental evidence is available. For this nucleus we have the measurements by Rutherford[2] of long range α-particles (nine groups) giving us approximate positions of nuclear levels. The investigations of Ellis[3] give for a number of γ-lines (nine lines) their absolute intensities and, what is most important, the values of internal conversion coefficients enabling us, as has been shown by Taylor and Mott[4], to tell the dipole transitions from quadrupole transitions.

These data are sufficient to construct the level system of the radium C′ nucleus, the main part of which is represented in Fig. 1, together with the theoretical one.

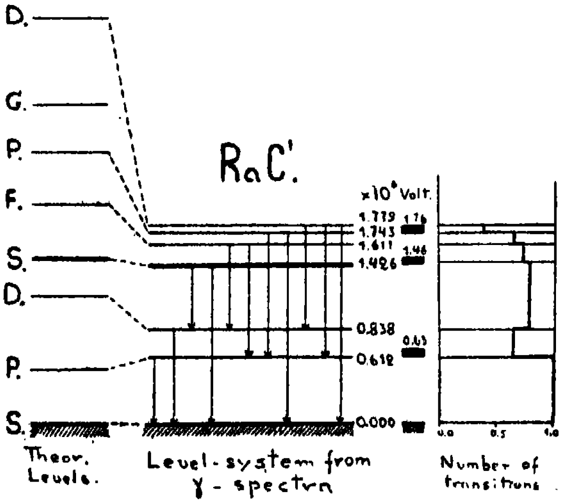

FIG. 1.

We see immediately that not every level corresponds to a long range α-group; this is, however, to be expected, as the probability of α-disintegration from a level with large j is comparatively small, due to the additional barrier of centrifugal forces (for equal energies the probability for an α-particle escaping from *P*-, *D*-, *F*-, *G*-levels will be respectively 1·3, 4, 16 and 105 times less than for the *S*-level). The observed transitions are given in the accompanying table.

CONSTRUCTED		OBSERVED		CONSTRUCTED		OBSERVED.	
$h\nu \times 10^{-6}$ volt	Δj	$h\nu \times 10^{-6}$ volt	Δj	$h\nu \times 10^{-6}$ volt	Δj	$h\nu \times 10^{-6}$ volt	Δj
0·588	2	0·589	..	1·131	0	1·130	0 ; 2
0·612	1	0·612	1	1·167	1	1·168	..
0·773	1	0·773	1	1·426	0→0	1·426	0→0
0·838	2	0·839	..	1·743	1	1·744	..
0·941	0	0·941	0 ; 2	1·779	2	1·778	0 ; 2
0·999	2	1·000	..				

From twenty-one mathematically possible transitions, eleven are actually found and, as can be seen from the table, have appropriate energies and obey the exclusion principle. From the remaining ten lines, two are not to be expected corresponding to $F \rightarrow S$-transitions, four fall in a spectral region not yet investigated and four are not observed, possibly due to comparatively small intensity. It is also of interest to construct an excitation diagram, building up the sums of the intensities for all lines crossing a given level interval. From this diagram we see that there must be a γ-line 0·226 × 10⁶ volt with absolute intensity about 0·2 which at present is not known.

The similarity of theoretical and real level systems proves the correctness of our picture of the potential inside the nucleus, and the deviations between these systems must permit us to calculate the real potential distribution.

G. GAMOW.

Research Institute of Physics,
University,
Leningrad.
Jan. 30.

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[1] Gamow, *Proc. Roy. Soc.*, A, **123**, 632; 1930.

[2] Rutherford, *Proc. Roy. Soc.*, A, **131**, 684; 1931.

[3] Ellis, *Proc. Roy. Soc.*, A, **129**, 180; 1930.

[4] Taylor and Mott, *Proc. Roy. Soc.*, A, **133**, 665; 1932.

Atomic Moments of Ferromagnetics

No satisfactory explanation has hitherto been given of the values found for the magnetic moment per atom in ferromagnetics, as deduced from the saturation magnetisation at low temperatures. These values for the three ferromagnetic elements are as follows:

Fe	Co	Ni	
11·0	c 8·6	3·0	Weiss magnetons
2·22	c 1·7	0·606	Bohr units

Now it is known from the experiments on the gyromagnetic effect that the g value for the carriers, at least at room temperature, is close to 2, while the form of the magnetisation temperature curves approximates closely to that for carriers for which $j = \frac{1}{2}$; the magnetisation may thus be attributed almost entirely to electron spin, any direct orbital moment effect, except possibly at higher temperatures, being comparatively small. A magnetic moment corresponding to an integral number of Bohr units per atom might therefore be expected.

To account for the non-integral values, two suggestions have been made (apart from those in which the reality of the Weiss magneton is accepted). In one of these (Stoner, 1926) the ferromagnetic is regarded as an equilibrium distribution of neutral atoms, ions and free electrons, the free electrons having no resultant moment, and the atoms and ions making contributions corresponding to their spin moments. In another (Wolf, 1931) a mixture of atoms in different possible spectroscopic states is postulated (for example, for nickel, ^3F and ^1D states, corresponding to moments of 2 and 0). To both of these suggestions there are a number of fairly obvious objections.

The essential fact which has to be explained is that the moment per atom in the aggregate is less than, though a considerable fraction of, the spin moment of the free atom in its normal state (2, 3 and 4 for nickel, cobalt and iron). It is suggested here that a satisfactory interpretation may be obtained by fusing the justifiable assumption of a positive interaction integral, the essential basis of the Heisenberg theory of ferromagnetism, with the treatment of the metallic state as developed by Bloch, Peierls, Brillouin, Wilson and others. The tendency to parallel setting of electron spins will be opposed by the tendency of the electrons to occupy the lowest 'cells' in the energy band or bands associated with the 'unpaired' electrons in the unperturbed atoms. Thus in nickel ($d^8s^2\ ^3F$) four cells are contributed to the aggregate by each atom, and two electrons.

The cells may be regarded as being in pairs corresponding to the two spin orientations for each momentum range. With normal interaction, the pairs of cells, from the lowest upwards, will be occupied by electrons with oppositely directed spin; but when the interaction integral is positive, there will be a number of uncompensated parallel spins. The equilibrium state will be that in which increase in the number of unpaired parallel spins, at the expense of the paired, corresponds to an increase in kinetic energy greater than the decrease in energy due to the interaction. The equilibrium is similar to that considered in the Pauli treatment of the constant paramagnetism of an electron gas, except that the tendency to parallel alignment is due to the interaction instead of to the external field. Numerically, the requirements are that the width of the energy band should be considerably less than kT_0 and greater than $k\theta$, where T_0 is the temperature corresponding to the zero point energy of the idealised free electron gas, of the order 10^4, and θ is the Curie temperature of the order 10^3. This width is compatible with the general theoretical indications.

The above treatment appears to lead also to a straightforward interpretation, in simpler cases, of the changes of atomic moment due to substitution of foreign elements in ferromagnetics, shown by Sadron's results for an extensive series of alloys, and to shed light on some of the obscure energetic characteristics of ferromagnetics. It is hoped that a more detailed account will be published shortly.

EDMUND C. STONER.

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Feb. 16.

Range of Radiation from Samarium

In NATURE of December 3 we announced the discovery of radiation of α-ray type emitted by samarium. Recently we have determined the range of this radiation. The apparatus used, to which Prof. H. Geiger had kindly directed our attention, consisted of a perforated Geiger-Müller tube, surrounded by a cylindrical brass tube, the inside of which was coated with samarium oxide. The whole system could be evacuated, and the pressure could be varied until no more α-particles reached the counter. From the air pressure and the distance between the samarium oxide layer and the counter, the range of the particles could be determined. The value for the range of the samarium radiation in air at atmospheric pressure was found to be $1{\cdot}1_3$ cm. at 15° C. The reliability of the method was checked by determining the range of the α-rays of radium F and a value of 3·90 cm. was found. Making use of the known relation between range and velocity of α-particles, we can conclude that particles having the velocity of $1{\cdot}05 \times 10^9$ cm. sec. ^{1} are emitted by samarium. That samarium emits α-particles and not H-particles could be proved by comparing the magnitude of the electrometric deflections obtained when counting the number of α-particles emitted by samarium, and also the magnitude of the deflections which polonium radiation produced, when the range of the particles was cut down to $1{\cdot}1_3$ cms.

The calculation of the period of samarium from the range of radiation by means of the Geiger-Nuttall relation when making use of Gamow's formula requires the knowledge of the size of the samarium nucleus. When we assume the radius of the latter to be 6×10^{-13} cm., we obtain 10^{15} years, while to a radius of 8×10^{-13} cm., a half period of 10^{12} corresponds. The period of samarium may be determined by counting the number of α-particles emitted by a known amount of this element. We find, that 1 gm. of samarium emits 75 α-particles a second. From this it follows that the half period of samarium is $1{\cdot}2 \times 10^{12}$ years. If the activity is not due to the main isotope of samarium, but to a minor isotopic constituent, then the above figure has to be divided by the value of the concentration of the radioactive isotope. By comparing the period calculated by means of the Geiger-Nuttall relation, when making use of Gamow's formula, and the period obtained by counting the number of α-particles emitted, we can calculate the amount of the concentration of the radioactive isotope of samarium. Although the value given by Gamow's formula varies within large limits, it still permits us to conclude that the activity of samarium cannot be due to an isotopic constituent present only in small amounts.

It may be of interest to note that Prof. Joly[1] has directed attention to the pleochroic haloes produced by an unknown α-radiation of short range. In biotite of Japan, Iimori and Yoshimura[2] discovered haloes produced by α-rays having a range in air of 1·2 and 2·1 cm. It is possible that the first-mentioned halo is due to the action of the samarium radiation.

Simultaneously with our first investigation on the radioactivity of samarium, we experimented with other rare earth elements, with the exception of numbers 61 and 69, and found several of the preparations tested to be radioactive. Lanthanum and neodymium especially have shown pronounced activity. The character of the radiation observed suggested, however, that the activity is due to the presence of known radioactive elements, and in fact we were successful, by using the usual reactions of radiochemistry, in removing the activity observed. The only member of the radioactive disintegration series which cannot be removed by simple methods is the rare earth element actinium. The disintegration of actinium is, however, a 'rayless' one.

In a recent note, Libby and Latimer[3] announced the discovery of the radioactivity of lanthanum and neodymium, and stated that the activity of the latter element is nearly as intense as that of samarium; while that of lanthanum was found by them to be about three times more active than samarium. We have, therefore, to conclude that this activity is not a property of the elements themselves, but belongs to the radioactive impurities present, a possibility mentioned by the above writers.

G. HEVESY.
M. PAHL.

Institute of Physical Chemistry,
Freiburg im Breisgau.
Feb. 13.

[1] *J. Chem. Soc.*, **125**, 897 ; 1922.

[2] *Sci. Pap. Inst. Phys. and Chem. Res.*, Tokyo, **66**, 11 ; 1926.

[3] *J. Amer. Chem. Soc.*, **55**, 433 ; 1933.

A New British Record of *Orthopodomyia pulchripalpis*, Rondani (Diptera, Culicidæ)

ON March 8 we collected a number of mosquito larvæ from a rain-filled cavity in a local elm tree, and found them to be the second, third and fourth instars of the arboreal mosquito *Orthopodomyia pulchripalpis*, Rondani. So far as we are aware, this species has never been collected in the adult stage; its eggs have never been obtained; and records of its larvæ are few and far between.

The British localities in which tree-holes containing larvæ of *Orthopodomyia pulchripalpis* have so far been recorded are as follows:—Epping Forest, Essex (A. Macdonald, 1919, and H. Main, 1919): Kensington Gardens and Buckingham Palace Gardens, London (F. W. Edwards, 1926): Burnham Beeches, Bucks (P. A. Buxton, 1928): Cambridge (D. Keilin, 1929, and T. T. Macan, 1931): Ripley, Surrey (M. E. MacGregor, 1930): and Hardwick, Cambs (T. T. Macan, 1932).

In the present instance, the cavity containing the larvæ is a natural rot-hole; its entrance, which faces north-east, is about three feet from the ground. On the day following our discovery of the larvæ we scraped some vegetable matter from the walls of the cavity, and on examining this in our laboratory we found within it a few eggs, and a number of egg-shells, which are undoubtedly those of *O. pulchripalpis*. Both in structure and in surface markings these eggs appear to correspond exactly with a published illustration of the egg of the North American species *Orthopodomyia signifer*, Coquillet (formerly *Bancroftia signifer*, Coquillet)[1]. According to Dr. F. W. Edwards, *O. signifer* is structurally allied to *O. pulchripalpis*, but differs from it by having scattered white scales on the wings[2]. It seems probable to us that not only the adults of these two species but also their eggs may likewise be differentiated by coloration; for the eggs of *O. signifer* are said to be black[3], whereas the eggs that we have now obtained are light brown. Presumably, therefore, our local tree-hole has yielded the first known specimens of the egg of *O. pulchripalpis*.

An unusual feature exhibited by the egg-shells is the fact that the plane containing the opening made by the emerging larva is inclined at an angle of about 45° to the axis of the egg, instead of being at right angles thereto as in the genera *Aedes*, *Theobaldia* and *Culex*.

In published descriptions of the larva of *O. pulchripalpis*, attention has been directed to the remarkable enlargement of the thoracic portions of the two main tracheæ. We find that each main trachea has, in addition, two quite conspicuous dilatations lying within the fifth to seventh abdominal segments. This peculiarity (which appears to have been hitherto overlooked) is especially noticeable in the second and third instars. We venture to suggest that these tracheal dilatations may have some relation to the air-sacs which lie within the seventh abdominal segment of the larva in the case of *Chaoborus* and *Mochlonyx*.

J. F. MARSHALL.
J. STALEY.

British Mosquito Control Institute,
Hayling Island.
March 13.

[1] Howard, Dyar and Knab, "The Mosquitoes of North and Central America", vol. 2, plate 145.

[2] *Ibid*, vol. 4, p. 890.

[3] Edwards, F. W., "A Revision of the Mosquitoes of the Palæarctic Region", *Bull. Ent. Res.*, vol. 12, p. 290.

Sporulation of *Helminthosporium avenæ* in Artificial Culture

IN 1923 an investigation was commenced on the fungus *Helminthosporium avenæ*. Recently an interesting observation was made and a note is now made of it.

Diversity of opinion exists as to the ease with which the various species of *Helminthosporium* produce spores in artificial culture. In view of conflicting statements, Turner and Millard[1] made a detailed study of a *Helminthosporium avenæ* culture. A wide range of media was used to embrace varying carbohydrate and nutrient contents, hydrogen ion concentration and sterilisation methods. No sporulation occurred on any of the cultures excepting on sterilised oat leaves, and then only sparsely.

I was myself unable to induce any marked sporulation until recently, when I inoculated two Petri dishes containing potato agar with mycelium from a non-sporing culture of *Helminthosporium avenæ*. Three days after the inoculation was made, the upper cover of the Petri dish was removed and a disc made from Sanalux glass was substituted. One half of the disc in both cases was painted over with Indian ink. Both cultures were then irradiated for ten minutes at a distance of one foot from a Hanovia quartz mercury-vapour home model alpine sun lamp, alternating current equipment, 200 volts. A subsequent irradiation was made for ten minutes, six days later. Seven days after this, the cultures were examined microscopically and it was noted that the mycelia on the irradiated halves were strongly pigmented and that very abundant sporulation had taken place: pigmentation was very slight on the non-irradiated halves and no sporulation had taken place.

Other experiments of a somewhat similar nature have shown that sporulation of *Helminthosporium avenæ* can be induced by irradiating with the light from a quartz mercury-vapour sun lamp; and also that sporulation will take place if non-sporing cultures are submitted, out of doors, to either strong diffuse light or sunlight. These experiments will be described elsewhere.

W. A. R. DILLON WESTON.

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Feb. 20.

[1] Turner, D. M. and W. A. Millard, *Ann. App. Biol.*, **19**, No. 4, 543–546.

Origin of Spontaneous Mutations

SPONTANEOUS mutations are generally supposed to be induced by some unknown external agent. However, it may be expected that mutation is influenced also by certain intracellular processes which develop automatically and may be created or accelerated by artificial means (for example, by X-rays).

Seeking to secure some additional evidence, I decided to test the effect of *prolonged dormancy of seeds* upon the rate of chromosomal mutations. Resting seeds were selected as material for the following two principal reasons: first, because the alleged external slight influences are able to accumulate only in material that is not exchanged or propagated during the whole period of experiment; secondly, because the anabiotic state is distinguished by the preponderance of katabolic processes, which may be supposed to disturb in the course of time the energy balance within the cell; and it seemed to be not improbable that such a disturbance would ultimately increase the rate of mutation.

In the early spring of the past year, two mixed lots of aged seeds of *Crepis tectorum* L. were planted in the usual manner. One of them, culture No. 32.593, was collected in 1925 from plants each of which was individually examined cytologically during that summer. At that time the rate of spontaneous dislocations was about 0·1 per cent or *one per thousand* (M. Navashin, 1926). The second lot, culture No. 32.594, came from plants grown in 1926 largely from the same 1925 seed. Both lots germinated poorly and mostly produced abnormal and weak seedlings. Among them were recorded many albinos; the majority displayed various developmental abnormalities and died before forming the growing cone or soon after. The whole population strikingly resembled one obtained from soaked seed which had been treated by a heavy dosage of X-rays (for *C. tectorum* such an effect is obtained from dosages about 3000 r).

Some thirty plants survived until they reached the age when they could be transplanted into pots. Some of them afterwards died, so that full maturity was reached by only twenty-seven of them, twenty-two of culture No. 32.593 and only five of culture No. 32.594. When the plants were about two months old, root tip material was taken from them individually for cytological investigation. The plants were kept under observation and displayed various abnormalities during their further development; many of them showed great reduction of fertility. Seeds were collected from them individually for further investigation.

The study of the root tips performed in collaboration with Miss Gerassimova of this Institute disclosed an astounding fact: *the great majority of the plants* (more than eighty per cent) *were chromosomal mutants of one sort or another*. None of the mutant plants was uniformly altered in all its cells, but all were *chromosomal chimæras* composed of at least two kinds of tissues, one with the normal chromosome complement and the other or others containing reorganised chromosomes. The great majority of mutant roots were uniformly altered in all their cells but in two instances chimærical roots occurred. The alterations observed were translocations involving one, two or more chromosomes. One case could be interpreted as inversion.

The data obtained were unusual to such a degree that it might be supposed that some special conditions were responsible for the situation. In order to check this, several lots of aged seeds of *Crepis tectorum* (of different origin) were germinated. Some of them produced rootlets that contained no division figures, but one lot of 1927 gave good material. In spite of the high percentage of germination (it was as high as 39 per cent) no normal seedlings whatsoever were produced. In all rootlets from this seed the chromosomes were found to be in a state of profound disintegration, and disregarding rare normal cells, each individual cell displayed a chromosome complement *sui generis*. Grotesque fragmentations, translocations, chains of chromosomes, etc., were observed. Resting cells contained degenerating globules of chromatin scattered throughout the cytoplasm, and adventitious small nuclei were not infrequent. Of special interest was the occurrence of ring-chromosomes, a phenomenon which has been found only once in a single seedling raised from fresh seed among many thousand individuals studied (M.N., 1931). Again the picture strikingly resembled that observed in seedlings fixed very soon after X-raying.

Fuller discussion of the subject, together with additional evidence which is now being accumulated, will appear in the near future in a joint paper with Miss Gerassimova. The purpose of this preliminary note is to report the above facts, which undoubtedly deserve earnest consideration. If the phenomena reported above should prove to be of wide occurrence, the process of mutation, it is evident, should be considered from a new point of view, the theoretical and practical bearings of which are obvious.

An attempt to evaluate them at this stage of our knowledge may seem to be premature. One is safe, however, in concluding that, first, selective mortality had absolutely nothing to do with the enormous increase in the rate of mutation discovered (cf. De Vries, 1901; Heribert Nilsson, 1931); for, granting that as much as one per cent of spontaneous mutants existed in the fresh seed (which is ten times the actual value) the percentage of germination should obviously have been only one per cent to account for 100 per cent mutants, while in reality as much as 39 per cent of seed germinated. Secondly, the observed increase in the mutation rate cannot be attributed to accumulation of the direct effects of some external agency like radiation and the like; for the ratio of mutants was shown not to be proportional to the length of the period of 'rest', but, on the contrary, must have grown with an enormous and progressive velocity until after five years it was a thousand times as great as after one year. One is forced thereby to the conclusion that the main agency that caused spontaneous chromosomal mutations should be sought not outside but rather *inside* the cell. The same would probably also hold true for factor mutations.

M. NAVASHIN.

Timiriazev Biological Institute,
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Moscow, U.S.S.R.
Jan. 20.

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Navashin, M. "Spontaneous chromosome alterations in *Crepis tectorum* L." *Univ. Calif. Publ. Agr. Sci.*, 6, 201-206; 1931.

De Vries, Hugo. "Die Mutationstheorie." Vol. 5. Leipzig, 1901.

Nilsson, N. Heribert. "Sind die induzierten Mutanten nur selektive Erscheinungen?" *Hereditas*, 15; 320-328; 1931.

Strepsinema Stage in Reduction

L. W. SHARP in his "Introduction to Cytology" (1st ed. 1921 and 2nd ed. 1926) and C. D. Darlington in "Recent Advances in Cytology" (1932) wrongly attribute the origination of the term 'strepsitene' to me. As a matter of fact, I never used this term, but suggested in 1899 the now generally used 'strepsinema'. I coined this word to describe the origin of the bivalent chromosomes of the heterotypic division first recorded by me in 1895 ("The Chromosomes of *Lilium longiflorum*", *Proc. R.I.A.*, 1895). The term 'strepsinema' is now often assigned to Grégoire owing, I believe, to an accidentally ambiguous expression of that writer, namely, "C'est le stade des noyaux *diplotènes* (Winiwarter, 00)—ou mieux noyaux *strepsitènes* ou *strepsinema* (Dixon, 00, Grégoire, 07), cette dernière expression rappelant les entrelacements caractéristiques de cette periode." ("Les cinèses de maturation dans les deux règnes" (second memoire). *La Cellule*, 26, 2, p. 239; 1910.) Grégoire, so far as I can discover, uses the term 'strepsinema' here for the first time.

With regard to the process of lateral approximation and twisting together of the separate chromosomes, now known to be homologous, and generally recognised as a normal stage of meiosis, I believe I was one of the first, if not the first, to observe and to describe it (*Proc. R.I.A.*, 1895 and "Notes from the Botanical School, T.C.D.", 1896). In this connexion I may again quote Grégoire: "La même année (1895) Dixon donne une interprétation toute différente. . . . Pour lui, les deux moitiés entrelacées qui constituent chaque chromosome, au moment où s'isole du peloton, ne sont pas le résultat d'une division longitudinale mais représentent deux tronçons du peloton qui, dès avant la segmentation transversale de ce dernier, se sont rapprochés et entrelacés. ("Les cinèses polliniques chez les Liliacées". *La Cellule*, 16, 2, p. 241; 1899.) Again p. 250: "Tous les auteurs, . . . , à part Dixon, décrivent cette division longitudinale. Dixon, au contraire, considère ces deux portions enroulées comme deux tronçons du peloton qui se seraient rapprochés et entrelacés." The view I put forward then is now generally accepted by cytologists, Grégoire included.

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Feb. 27.

Variation Effect in Latitude, Correlatable with the Moon

IN NATURE of January 26, 1929, p. 127, a communication appeared dealing with the variation of latitude with the moon's position. Attention was directed to small variations of less than a tenth of a second of arc, determined from Gaithersburg observations, which appeared to be correlated with the hour angle and altitude of the moon. While in this preliminary note a marked dependence was exhibited of the magnitude of the latitude residuals upon the moon's position with respect to the observer at the time the zenith telescope observations were made, no direct attempt was made to separate the dependence of the moon's hour angle from that of the moon's declination.

Studies of the small variations in latitude (corrected for the 428-day term) have been systematically continued for other stations and years, yielding results of increasing interest.

Reductions have now been carried out for four of the international latitude stations for the years 1909-11, and the resultant residual variations in latitude grouped both by hour angle and declination of the moon. The accompanying graph (Fig. 1) shows the results for north declination, south declination, and for the time when the moon is near the equator between − 12° and + 12°.

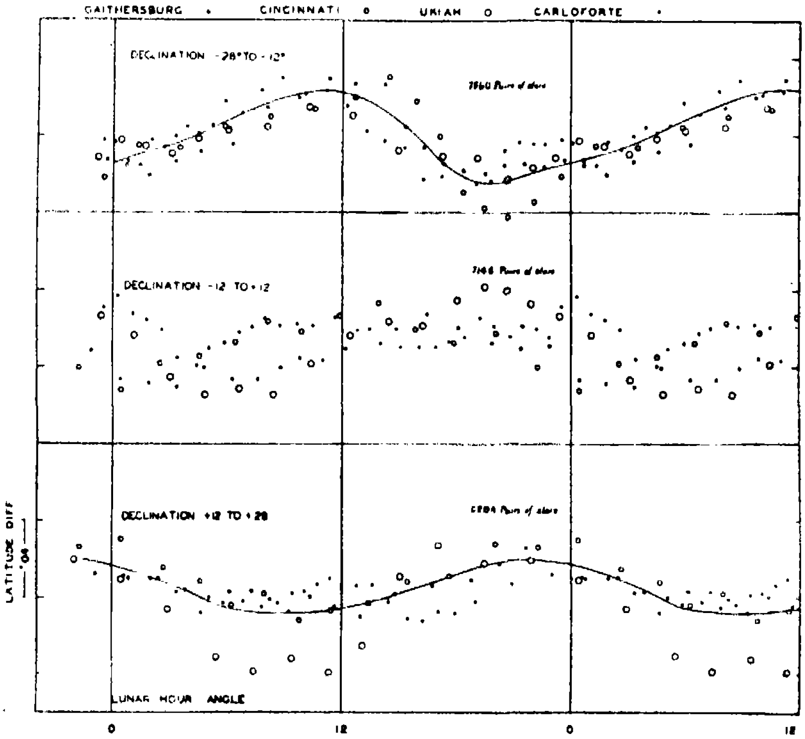

FIG. 1. Variation in latitude with the moon's hour angle and declination, 1909–11.

The resemblance of these curves to diurnal curves of equilibrium tides appears to give confirmatory evidence for an earth tide hypothesis. The inversion of phase for the change in the moon's declination is particularly significant in this respect.

The magnitude of the effect observed being 5–10 times greater than on the basis of our present knowledge of earth tides, suggests a possible mobility in the earth's crust at right angles to gravity. Some such hypothesis appears consistent with the results of tilt experiments, such as that of Michelson and Gale, and the displacements of the zenith here recorded in astronomical observations.

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Jan. 24.

Structure of Triatomic Molecules

RECENT investigations of infra-red and Raman spectra of triatomic molecules have shown that molecules with an odd number of electrons, such as ClO_2 and NO_2, are similar in structure to the molecules SO_2 and CO_2, each with one more electron. This observation suggests that the triangular molecules have structures depending on the number of valence electrons binding the three atoms together, and that a scheme might be formulated for obtaining the structures of these molecules from the total number of available valence electrons.

A stable structure is first obtained with four electrons. Examples are H_2O and Cl_2O, molecules which have surprisingly similar structures: both have vertical angles near 90°, both satisfy only the central system of force constants, and both show a large resistance to deformation measured by H–H and Cl–Cl force constants of at least 5×10^5 dynes/cm.; further, the O–H and O–Cl force constants are each 7×10^5 dynes/cm., corresponding to single chemical bonds. In fact, these molecules are excellent examples of the Slater-Pauling molecule formed from a central atom with two *p*-electrons available for chemical bonds.

Proceeding one step further, a fifth electron is added and a new structure, that characteristic of SO_2, is obtained. ClO_2 has five available valence electrons, has a vertical angle near 120°, satisfies only the valence system of force constants, and resists deformation to a much less degree than either H_2O or Cl_2O, its tangential restoring force constant being $3 \cdot 5 \times 10^5$ dynes/cm. These structural properties are all repeated in SO_2, where the sixth electron completely fills the SO_2 type of proper function; this is the one feature distinguishing SO_2 from ClO_2, for the S–O force constant is approximately $9 \cdot 6 \times 10^5$ dynes/cm. whereas the Cl–O constant is only 7×10^5 dynes/cm., indicating that the sixth electron of SO_2 brings out the full bonding power of this type of proper function.

Next we seek a molecule with seven electrons; the typical example is NO_2. The addition of a seventh electron again requires formation of a new type of proper function, and this is characterised by a linear structure and small resistance to deformation, measured by a restoring couple constant of $5 \cdot 5 \times 10^{-12}$ dynes × cm. Addition of an eighth electron fills this linear type proper function, and raises the force constant of the chemical bond from 7×10^5 to 14×10^5 dynes/cm. Addition of the eighth electron does not otherwise affect the structure, the similarity of the restoring couple constants being a remarkable feature of the linear molecules NO_2, N_2O, CO_2, COS and CS_2. The C–S force constant is less than 14×10^5 dynes/cm., and may be accounted for by the increased separation of the nuclei.

The above scheme seems also applicable to triatomic radicals, and has been used to explain apparently inconsistent structures observed for the NO_2 group[1]. It also predicts an SO_2 structure for NOCl, and preliminary observations of the infra-red absorption spectrum appear to confirm this.

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Feb. 22.

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[1] Bailey and Cassie, NATURE, 131, 239, Feb. 18, 1933.

Hydroxyl Group in Ergosterol and Cholesterol

IN a recent issue of the *Annalen*[1] is a paper by Chuang in which the conversion of ergostane into *allo*-norcholanic acid, $C_{23}H_{38}O_2$, is described. This result is of considerable interest as it definitely establishes the identity of the nuclear skeletons of ergosterol, cholesterol, and the bile acids.

We have also been investigating the same question with the additional object of determining simultaneously whether the hydroxyl group in ergosterol is in the same position as in cholesterol which, as has been shown by Wieland and Dane[2], is almost certainly attached to carbon atom 3. With this object in view we have oxidised ergostanyl chloride, $C_{28}H_{49}Cl$, with chromic anhydride and have isolated a chloro-acid, m.p. 213°, analysis of which shows that it is a chloronorcholanic acid (found: C, 72·7; H, 10·0; Cl, 9·7 per cent; required for $C_{23}H_{37}O_2Cl$: C, 72·5; H, 9·7; Cl, 9·3 per cent). The formulation of this acid has obviously occurred by scission of the ergostanyl side-chain in the following manner:—

$$-\mathrm{CH(Me)CH_2CH_2\;CH(Me)CHMe_2} \quad\cdot\quad -\mathrm{CH(Me)CH_2COOH}$$

We are now engaged in degrading 3-chloro-*allo*-cholanic acid[3], $C_{24}H_{39}O_2Cl$, to the corresponding *nor*-acid in order to establish its identity or otherwise with our acid.

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March 17.

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[1] *Ann.*, **500**, 270; 1933.

[2] *Z. physiol. Chem.*, **212**, 41; 1932.

[3] Windaus and Hossfeld, *Z. physiol. Chem.*, **145**, 177; 1925.

Constitution of Binary Alloys at Room Temperature

WHEN studying binary organic melts, it is customary to supplement the information obtained from the freezing point curve as to compound formation, solid solutions, etc., by examining the solubility isotherms. In this way, not only can it be decided whether or not the composition of a cold mixture is essentially the same as at its freezing point, but also a very fair approximation to the transition point of a compound can often be obtained by means of a solid model or projection diagram. For the purpose of the solubility measurements, the nature of the solvent is considered immaterial and solvation is not supposed to affect the range of stability of the compound.

This being the case, it occurred to me that a similar procedure might be applied with equally reliable results to binary alloys, using mercury as solvent, and plotting the results on a triangular co-ordinate diagram. Mr. H. D. Carter, working in my laboratory on the system mercury–manganese–tin, at 30°, is obtaining results which show that the procedure is feasible. Dilute tin amalgams are used as cathodes and manganese electro-deposited up to the appearance of solid phase. Perhaps the method may become of general application in metallurgical work.

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Research Items

Archæological Discoveries in Uganda. Mr. E. J. Wayland figures and describes in *Man* for February relics of a culture at present unidentified from a site at the top of Luzira Hill, Port Bell, Uganda, of which the first indications were some remarkable heads of pottery figures found by natives in the course of building operations. A stratum of angular granite rubble, thought to be of middle Pleistocene or post-middle Pleistocene age, was found to contain artefacts belonging to two groups, one contemporaneous, the other derived. In a stratum of red earth above, were elongated continuations of the surface soil which were found to contain parts of pottery figures and a number of fragments of pottery vessels, all of which had been broken before being deposited in the pits. The pits were circular in horizontal section and showed no sign of any interment. On a hill-top a quarter of a mile away was found a shrine consisting of an earthenware pot containing rain water and a few coins and having a number of spears arranged point inward and other objects around it. Although the shrine is still or was until recently in use, the natives know nothing of its origin. Mr. Miles Burkitt, reporting on the stone artefacts from Luzira, considers the industry of great interest and compares it with that found by F. B. Macrae in the Kafue district of Northern Rhodesia, in a cave near Mumbwa. Mr. H. J. Braunholtz considers that the objects from the pits are older than those from the shrine. The pottery figures are remarkable for the head-dress and also for the conventional treatment of the body. In one figure the thighs are omitted. The figures are unique in African art. One small fragment of pottery has an ornament still in common use among the Baganda. These finds are probably only a few centuries old. Among the objects from the shrine the iron spear heads with tangs are peculiar for Uganda, while those with sockets and an eyelet between blade and socket are not a modern Baganda type and cannot be matched in the British Museum collections.

Ceremonial Exchange in Polynesia. Ceremonial exchanges of gifts, frequently mentioned by writers on Polynesia, apparently are quite meaningless from the economic point of view and indeed at times the gifts exchanged are of the same kind. A study of these ceremonial exchanges in Ontong Java, the Polynesian community in the Solomon Islands, by Dr. Ian Hogbin in *Oceania* (vol. 3, pt. 1) shows, however, that benefits are derived from these exchanges in various ways and that their uselessness is more apparent than real. In Ontong Java elaborate exchanges of food take place on various occasions. In betrothal, the most important, the father of the girl announces the fact to the head of his family group, through whom the announcement is conveyed to the headman. The headman immediately gives orders that the women of the group are to collect taro, which is brought to the house of the mother. The father and mother's brother in the meanwhile collect a number of coco-nuts, and a pudding is made, which when cooked is distributed among the women of the two groups concerned. The father of the boy also announces the betrothal to his headman, who decides how many coco-nuts are to be collected and gives orders for the men of the group to collect the nuts and also fish. The boy's mother's brother's group also collect nuts. The points to be noted in these exchanges are that, apart from any question of material gain, they bring the headman and the father prestige, and afford an outlet for pride and vanity without harm to other members of the community; they form a bond and impose a mutual obligation on two groups of the society as well as between individual members of the group; they emphasise the mutual relations of the head of the group and the individual member; and they also serve to stabilise marriage. They legalise the marriage, and establish the legitimacy of the children.

Restriction in Range of the Long-Billed Curlew. The long-billed curlew (*Numenius americanus*) once ranged over the entire width of the United States of America, where it frequented open prairie and the flat land about the marshes of the Great Salt Lake and similar localities. John W. Sugden (*Condor*, Jan. 1933, p. 3) points out that with the advance of civilisation and the cultivation of the prairies, the range of this curlew has been pushed westwards, so that the numbers now seen on the marshes and flats of Great Salt Lake represent rather a concentration in a restricted range than an increase in the number of birds. Actually there is a notable decrease in numbers. Even where cultivation is made impossible by the high alkalinity of the soil and poor drainage, nesting is disturbed by the increase of grazing stock of cattle and sheep. The latter especially destroy nests by trampling, so that the curlews are driven to less accessible and less suitable nesting territory. The area now occupied by the long-billed curlew is a limited portion of the Great Basin, but further restriction appears to be inevitable in view of the attempts to drain alkaline sloughs and the extension of sheep ranging.

Nephridia of *Amphioxus*. Prof. E. S. Goodrich (*Quart. J. Micro. Sci.*, 75, pt. 4, Feb. 1933) gives a new figure of the nephridia of *Branchiostoma* (*Amphioxus*) which shows that the number of blind branches bearing solenocytes is considerable and that the anterior canal attached to the primary gill-bar may be more than 0·3 mm. long. The paired nephridia of the allied genus *Asymmetron* (*A. lucayanum*), which were studied at the Biological Station, Bermuda, are built on the same plan as those of *Branchiostoma* but are smaller and simpler. From the pore, which opens into the atrium near the top of the secondary bar, the canal runs dorsally and expands into a triangular sac from the dorsal edge and outer surface of which the solenocytes chiefly arise. The solenocytes are rather larger than those of *Branchiostoma* and the tube of each, down which works a long flagellum, may reach a length of about 0·04 mm. The paired nephridia are retroperitoneal but the coelomic epithelium is interrupted and does not cover the solenocyte field so that coelomic fluid bathes the solenocyte tubes. The blood supply of the nephridium seems to be much less developed than in *Branchiostoma* and the conspicuous network of blood-capillaries described in the latter by Boveri is represented by only a few slender vessels in *Asymmetron*. In

Asymmetron as in *Branchiostoma*, Hatschek's unpaired nephridium is present, extends along the lateral wall of the left dorsal aorta and opens posteriorly and dorsally into the pharynx by a small pore just behind the velum. This nephridium reaches forwards slightly beyond Hatschek's pit and in the adult is nearly 2 mm. long. Along the course of the slender main canal are small dorsal and ventral solenocyte chambers into which penetrate branches of solenocytes from diverticula of the canal.

Late-Blight of Tomatoes. The fungus *Phytophthora infestans* is well-known in Great Britain for the damage it causes to the potato crop. In many parts of the United States it is also a serious menace to the extensive fields of tomatoes. Circular No. 169 of the United States Department of Agriculture ("Tomato Late-Blight Rot, a Serious Transit and Market Disease" by G. B. Ramsey and Alice A. Bailey, 10 pp.) describes the disease in detail. The symptoms are superficially like those of potato blight. Leaves are blackened and hang down from the stems, which in turn fall over. Wet seasons induce the abundant production of mycelium over the surface of affected parts. Fruits are also attacked, with the formation of watery brown places which may gradually extend all through the tomato. The fungus is capable of developing very quickly amongst fruit packed for transit, and large losses have been recorded at this time, though very little spread occurs from one fruit to another. Various treatments of freshly-picked fruit with water and with weak formaldehyde solution have failed to arrest development of the rot during transit, but spraying with Bordeaux mixture is a preventative when applied to the growing plants.

Differentiated Sills in Skye. The lower members of the great group of basic sills intrusive into the Jurassic strata of the coast of Northern Trotternish (Skye) form the subject of an investigation by Dr. F. Walker (*Trans. Roy. Soc. Edin.*, **57**, No. 7, 1933). Ophitic olivine-dolerite is the most widespread type of rock, but there is a noteworthy development of picrite in the thicker sills. Gravitational settling of olivine crystals can be clearly demonstrated in the well-known sill that forms the Kilt rock, and the process is thought to have occurred in other sills. In some examples, instead of a comparatively thin layer rich in olivine near the base, picrite occurs as the most abundant rock with relatively thin olivine-dolerite margins. It is shown that the lower members of the visible suite of sills contain considerable amounts of ultrabasic rock, and it is argued that differentiation must have been drastic in the feeding reservoirs, producing great accumulations of peridotite of which the Trotternish sills reveal samples. The recent suggestion that the non-porphyritic central magma type represents the parental magma of the Tertiary igneous rocks of this province is discussed. It is pointed out that it would seem to imply the production of a great preponderance of quartzose types over basic rocks of plateau magma type. Such preponderance is not indicated by the existing field evidence, which is thus at variance with the suggestion.

Soundings in the Scotia Sea. The waters of the Southern Ocean between Drake Strait and the South Sandwich Islands, west and east, and between the Falklands and South Georgia on the north and the South Shetlands and the South Orkneys on the south, are now known as the Scotia Sea in honour of the work of Bruce's expedition in the *Scotia* in that area. They would appear to be surrounded, except on the west, by a great hairpin ridge, partially submerged, which was originally known as the South Antillean Arc but is now called the Scotia Arc. Many thousands of soundings taken in this region by *Discovery II* and associated ships are recorded on charts published in "Discovery Reports", vol. 6. "Report on Soundings taken during the Discovery Investigations 1926–1932". By H. F. P. Herdman (Cambridge University Press, 15*s*.). Most of the soundings were taken by the echo methods, which admitted of seried rows of soundings where formerly the scattered observations of *Scotia* and *Antarctic* were almost the only data. Mr. Herdman discusses the probability of the Scotia Arc being a line of folding and shows that the weight of evidence, both oceanographical and geological, is in favour of a structural connexion between South America and Graham Land. Folded large-scale charts are provided in a separate case and coloured bathymetrical charts, which show earlier soundings also, are bound into the report.

Isotopes of the Radio Elements. The *Physical Review* for January 1 contains several papers describing applications of the Allison magneto-optical method to finding metallic isotopes. This method consists in observing the Faraday magneto-optical rotation produced by solutions of the metallic salts and measuring the lag between the application of the field and the appearance of the optical effect. The light from a spark is polarised and passed through cells over which are wound magnetising coils fed with high-frequency currents from the spark circuits. One of the cells contains the solution under investigation, and the other contains a comparison liquid. The coils produce opposite rotations and the occurrence of a characteristic time of lag is detected by a minimum in the light intensity as the optical path between the cells is changed. Even with very dilute solutions, it is claimed that the presence of molecules of a particular isotopic variety makes itself evident by the occurrence of a characteristic lag. In the papers under notice, the method is applied to lead (sixteen isotopes), bismuth (fourteen isotopes), radium (four isotopes), uranium, thorium and thallium (eight isotopes each). The abundance of the isotopes in the specimens was estimated from the minimum concentrations in which the characteristic lags could be observed. On the basis of the isotopic constitutions found for these elements, Edna R. Bishop constructs a table of the radioactive elements and their relations which is in good accord with the known facts of radioactivity.

Philips Sodium Lamp. A notable improvement in the efficiency of certain sources of monochromatic radiations has resulted from the recent development of the hot-cathode discharge tube. An interesting example of the new type of source is the Philips sodium lamp, a specimen of which has been submitted to us by Philips Industrial, 145 Charing Cross Road, London, W.C.2. The lamp consists of a small glass envelope containing a coiled filament, which constitutes the cathode, two other ring-shaped electrodes, and small quantities of inert gas and sodium. The lamp operates from A.C. mains, of voltages from 215 to 230, in association with a rectifier which provides heating current for the filament and the requisite low voltage for the glow discharge. The visible spectrum of the lamp immediately after starting is due chiefly to the inert gas, but the heat generated by the discharge vaporises some of the sodium, and the spectrum of sodium gradually supersedes that of the gas. Maximum brilliancy is attained within 10–15 minutes after starting the lamp, and the spectrum then consists entirely of sodium lines, the yellow *D* lines being by far the most intense. The other lines, situated in red, green and blue regions, can be removed, or reduced to very low intensity, by using a yellow gelatine filter or a potassium bichromate cell. The brightest portion of the source consists of a central cylinder about 2·5 cm. long and 2·5 cm. in diameter. A Dewar flask and a polished metal radiation shield are provided with the lamp for maintaining it at the appropriate operating temperature. The lamp is simple to operate, provides a highly intense and steady source of the *D* lines, and has many obvious laboratory applications, particularly in colorimetry, polarimetry and refractometry.

Detection of Traces of Carbon Monoxide in Air. The extremely poisonous character of carbon monoxide and its presence in the exhaust gases of motor-car engines render the easy detection of traces of this compound a necessity of modern life. The lowest concentration of carbon monoxide in air which will produce fatal results when breathed is said to be not greater than 0·1 per cent and has been computed by Hempel to be about 0·05 per cent. In the *Chemiker-Zeitung* of February 25, Dr. W. Ackermann of Breslau describes the results of comparative tests made with the two reagents which have hitherto been regarded as being most sensitive to carbon monoxide, namely, diluted ox-blood and palladous chloride. Hæmoglobin is said to absorb carbon monoxide about 130 times as readily as oxygen, but differentiation between the absorption spectra in the two cases is only possible after the addition of a reducing agent (ammonium sulphide), when the characteristic bands disappear unless carbon monoxide has been absorbed. On the other hand, the gas reduces palladous chloride very readily to the free metal and the colour and transparency of the reagent may be observed during the whole course of the experiment. Even when no deposit can be seen by the naked eye, its presence can sometimes be revealed by filtering the solution. The results are very striking. By passing 1 litre of air containing varying small amounts of carbon monoxide through the reagents for one hour, it was possible to detect 0·015 per cent of the gas by the palladous chloride method, as against 0·13 per cent by the hæmoglobin method.

Astronomical Topics

Geddes's Comet. This comet has now been observed for more than eight months, but is still a fairly easy object, and is likely to be followed for most of 1933, if not longer. *Astronomische Nachrichten*, No. 5934, contains a fine series of observations extending from June to December, made by J. Tretter at Cordoba Observatory (Argentine).

The comet is now in north declination 10°, and is observable for most of the night. Since its orbit is probably hyperbolic, it is important to keep it under observation. It was observed by M. Beyer at Hamburg on March 1. It was an oval nebulosity 2′ in diameter, the combined light being of mag. 9·7, and the nucleus of mag. 11·6. An ephemeris for the whole year is given in the Handbook of the British Astronomical Association for 1933; the error of the ephemeris does not exceed 2′ or 3′.

Variable Stars in the Globular Cluster M.53. It was the study of cluster-variables that led to the important law correlating period with absolute magnitude; this law permitted determinations of distance to be made in the case of objects beyond the range of all previous methods. Herr E. Grosse, of the Bergedorf Observatory, has made a study of the variables in Messier 53, in Coma Berenices (*Astr. Nach.*, 5901). Light curves are given for thirty-four variables. Most of these are of the characteristic cluster type, with rapid rise and slow decline, but a few of them conform more closely with regular sine curves.

The distance of the cluster is determined as 19,500 parsecs; Prof. Shapley had found 18,200 parsecs by rougher methods (diameter of cluster, total light, and magnitude of brightest stars). Grosse's value places the cluster 3,700 parsecs from the galactic plane. Its diameter was reckoned from the angular distance of the outer variables from the centre, and found to be 89 parsecs, about the same as Messier 3 and Messier 5. It is estimated that 7 per cent of the stars in M.53 are variable; in ω Centauri the percentage is 4, in M.3 it is 15.

Minor Planets. The volume of "Kleine Planeten" for 1933, just published by the Berlin Rechen-Institut, gives evidence of the zeal of many astronomers both in discovering new planets and in keeping the known ones sufficiently observed. The planets with permanent numbers now extend to 1,223, having increased by 40 during the year. Each year a list is given of planets for which observations are specially desired. 35 of the objects thus listed last year have been re-observed. Orbit elements are given for all the numbered planets. Dr. Witt gives a revised orbit of 433 Eros, which he discovered in 1898; the new elements, for 1925, Jan. 1·0 U. T. are: M 204·560°, ω 177·945°, Ω 303·710°, i 10·830°, Φ 12·879°, n 2,015·258″, a 1·4581. The interesting planet 944 Hidalgo, which travels out to Saturn's orbit, has been out of sight for ten years; it may possibly be seen by southern observers next September, its magnitude being 15·4.

The remarkable planet discovered by M. Delporte a year ago, which approaches the earth within ten million miles, has now the number 1,222, and the name Amor; an ephemeris is given for next October, but as its magnitude is 21, its recovery can scarcely be expected. The tenth Trojan planet, 1,208 Troilus, was in opposition on December 31, 1932, in north declination 55°, magnitude 15·2. Eros is in opposition on June 27 in south declination 36°, magnitude 11·1.

The New Compressed Air Wind Tunnel at the National Physical Laboratory

THE new compressed air tunnel for aeronautical research at the National Physical Laboratory, recently completed and now being brought into use, is the largest and most up-to-date of its kind, and the second one only in the world. A small tunnel on the same principle has been working in the United States for several years, and the British one has incorporated in it many new features found desirable during the use of this earlier type.

The theoretical basis of the new compressed air tunnel at the National Physical Laboratory is to be found in Rayleigh's law of dynamical similarity, upon which the validity of all model research in aerodynamics rests. This law may be written

$$R = \rho v^2 l^2 f(vl/\nu)$$

where R is any particular aerodynamic reaction, for example, the lift or the drag of a model aeroplane, v is the relative speed, ρ is the air density, l is a characteristic length of the model, ν is the coefficient of kinematic viscosity of the air, and $f(vl/\nu)$ represents some function of vl/ν which cannot be determined theoretically. The implication of this law in predicting full-scale characteristics from model tests is obvious. Thus if the model is tested at atmospheric pressure and temperature, the only way to be absolutely certain of predicting full-scale forces accurately is to test at the same value of the product vl.

A simpler approach to tests under these conditions, except in the matter of size, is seen in the very large wind tunnel, having a jet measuring 60 ft. × 30 ft., recently erected in the United States. Testing on such a large scale is very convenient for some purposes, but for most branches of research it is preferable to work with smaller models. In many cases the variation of the function $f(vl/\nu)$ with scale is not serious, so that tests in an ordinary atmospheric pressure wind tunnel of moderate size give all the accuracy required. Ample justification for ignoring changes in $f(vl/\nu)$ between tunnel and full-scale has now been provided by the agreement between full-scale flying measurements and model results obtained in such tunnels. But in some instances, notably the maximum lift coefficients of aerofoils, there may be a pronounced 'scale effect', that is, change in $f(vl/\nu)$ with scale or speed. It is here that Rayleigh's law provides a relatively simple solution, for the quantity ν varies inversely as the pressure, so that if the air is compressed to n atmospheres, the model scale by speed product can be reduced in the ratio $1/n$ without affecting the value of $f(vl/\nu)$. This principle is made use of in the new compressed air tunnel, in which the air can be compressed to 25 atmospheres. The maximum wind speed in the six-foot diameter jet is about 60 miles per hour, so that tests at full pressure on a 1/10 scale model simulate precisely the conditions of the full-scale aircraft flying at 150 miles per hour.

The working section in which models are tested is 6 ft. in diameter. The air flowing through this section returns through an annular space surrounding it, being circulated by a fan. This requires a diameter of 17 ft. for the containing shell, which is made of steel nearly 2½ in. thick. The shell was designed and made by Messrs. John Brown and Co. Ltd., of Sheffield, and consists of four rings, each rolled from a single ingot, and jointed together by circumferential straps fitting over slight flanges on the ends of the rings. The four rings together form a cylinder 17 ft. in internal diameter and 32 ft. long. The ends of this cylinder are each completed by two steel castings forming a hemisphere. At one end is a special labyrinth packing through which the fan shaft passes to the external driving motor, while the other end has a door for access to the tunnel. The internal air passages forming the wind tunnel itself were designed at the National Physical Laboratory by tests on a small model, modifications being made until the uniformity of the air flow was satisfactory. In the actual tunnel, the internal structure is built entirely in steel, light castings being used in the curved portions, and steel plates on suitable framing in the straight parts. A honeycomb is introduced at the point of lowest air speed to straighten the flow, and is immediately followed by a rapid contracting jet just before the working section is reached. This results in very steady and uniform distribution of speed across the working section. The air is circulated by a metal airscrew or fan driven by a 400 h.p. motor. Air is compressed into the shell by three 400 h.p. compressors housed in an adjoining room, and capable of charging the shell to the full pressure of 25 atmospheres in about ninety minutes.

An observer cannot work inside the tunnel at this high pressure, and the readings of the balances on which the models are suspended have to be recorded outside. This is done by an extremely interesting and unique electrical apparatus which can transmit the readings to any point as desired. The air forces to be measured are balanced by electromagnetic attractions between coils of wire, the current in which is controlled from outside. The current required for balance is measured and thus gives a direct indication of the air force acting on the model. Certain movements of the model are also made by electric motors controlled from outside the tunnel.

Selectivity and Radio Communication[*]

IT has long been a commonplace remark that one of the greatest problems in the technique of radio communication is the avoidance of the reception of undesired signals. Improvement and developments in methods of reception have made it comparatively easy to receive intelligible signals from almost any transmitting station under a variety of conditions, but these methods increased rather than reduced the difficulties of eliminating interference due to signals emanating from stations other than the one from which it is desired to receive. For telegraphic communication the difficulty has in the past been partially overcome by increasing the selectivity of the receiving circuits so far as stability would permit, but the use of shorter wave-lengths and of directive aerial systems has also contributed to the solution. With the inception of broadcasting and

[*] F. M. Colebrook: "A Theoretical and Experimental Investigation of High Selectivity Tone Corrected Receiving Circuits", Radio Research, Special Report No. 12. (London: H.M. Stationery Office, 1932.) 1*s*. 3*d*. net.

the rapid development of emitting stations in restricted geographical areas, the effects of radio interference have been brought home to a much wider public.

On a first inspection of the problem as applied to the reception of speech and music, as in telephony or broadcasting, it appeared that the relatively high selectivity of the telegraphic circuits could not be utilised on account of the distortion which would arise from the loss of the higher note frequencies in the audible range. Recent research has shown, however, first, that the problems of the reduction of interference are the same in all branches of radio communication; and secondly, that the correct application of existing knowledge on radio frequency circuit operation can be of considerable assistance in reducing the interference experienced in any conditions of radio reception.

On account of the importance of this subject, the Radio Research Board appointed a special committee, under the chairmanship of Prof. E. V. Appleton, to report on the properties of very highly selective radio receivers. On behalf of this committee, Mr. F. M. Colebrook carried out a theoretical and experimental investigation of the subject, and the results of this work, together with the committee's considered conclusions on the problems involved, are contained in a report recently published by the Department of Scientific and Industrial Research.

In the course of this investigation the general problem of the reception of modulated electrical oscillations in a circuit of known constants has been considered in a comprehensive manner. The research has been limited in the first place by the assumption of quasi-stationary conditions, and it is realised that the results of imposing transient conditions will need further consideration. Moreover, the investigation was specially directed to studying the behaviour of a circuit of high selectivity, that is, a tuned oscillatory circuit in which the current amplitude falls very rapidly as the frequency of the inducing electromotive force is displaced by comparatively small amounts from its resonant value. The practical application of this work consists in the use of such a high selectivity circuit as part of the apparatus employed for receiving modulated radio signals in the presence of similar signals at neighbouring radio frequencies which it is not desired to receive. The distortion already referred to which results from the gradual amplitude reduction with increasing modulation frequency may be corrected for by using one or more audio-frequency stages in which the amplification obtained increases with the frequency in the requisite manner.

In the case postulated, the desired signals may be assumed to consist of a carrier wave with associated side waves due to telephonic, telegraphic, or other modulation, and it is by the combination of the effects of these waves in the receiver in their correct phase relationships that reception takes place. Under the conditions stated above, the total interference can be classified into two groups. The first includes all interference which would exist even in the absence of the carrier wave of the wanted transmission. A familiar example of this is the reproduction in a broadcasting receiver tuned to a certain station of the programme of another station transmitting on a neighbouring frequency or wave-length. The second group comprises all interference which would disappear completely if the carrier wave of the wanted transmission were removed. The most important and familiar example of this type of interference is the steady heterodyne beat note resulting from interference between the carrier waves of the wanted and unwanted transmissions.

The results of the investigations of this case show that, by the use of a highly selective receiving circuit in combination with a suitable tone-corrected audio-frequency amplifier, interference of the first type can be reduced to almost any desired extent within certain practical limits of circuit and transmission frequency stability. In the case of interference of the second type, however, the position is totally different in that the magnitude of this interference is independent of circuit selectivity, the relative reduction of interference in the selective circuits being removed by the subsequent tone correction. On account of the presence of this second type of interference, the frequency difference between the carrier waves of the wanted and unwanted transmissions must be at least twice as great as the audio-frequency range it is required to cover in the modulation signals transmitted and received. The advantage to be gained by the reduction of the first type of interference is considerable, and it is likely that the principles, now well established, will attract considerable attention in the future of radio receiver design and practice. The principles apply equally to all classes of receiving apparatus, whether these are for broadcast reception, for telegraphic reception using Morse code signals, or for the reception of those modulation signals which are employed in television and picture telegraphy.

The Priestley and Pepys Commemorations

WHEN Priestley on April 8, 1794 left the shores of England to seek an asylum in the United States, he could little have thought that nearly a century and a half later his name would be on everybody's lips and that men of light and learning would gather together in many places to pay tribute to his memory. After fleeing from Birmingham in 1791 in fear of his life, he had reached London only to find himself shunned by many of his fellow members of the Royal Society, and as the French Revolution, for which he had at first had much sympathy, reached its climax, his position had become so unpleasant, if not hazardous, that he was driven to the conclusion that his removal would be of more service to the cause of truth than his longer stay in England.

Thus it came about that just a month before France saw her greatest man of science fall beneath the guillotine, England allowed one of her noblest sons to become a voluntary exile. To-day, however, the name of Priestley, like that of Lavoisier, is held in honour throughout the world and the celebrations which have recently taken place in London and elsewhere have done much to atone for the neglect shown him in his later years.

Of these celebrations the most important was that of March 15, when at Burlington House the president of the Royal Society, Sir Frederick Gowland Hopkins, held a reception to commemorate both the bicentenary of the birth of Joseph Priestley and the tercentenary of the birth of Samuel Pepys. Needless to say, the rooms in which Sir Frederick received the guests were not the apartments known to Priestley, for when in 1773 at the hands of Sir John Pringle he received the famous Copley medal, the Society was still housed in Crane Court, whence, seven years later, it removed to Somerset House. But no doubt Priestley would have found much with which he had once been familiar, for when he was admitted a fellow of the Society in 1766, the Society was more than a hundred years old, and among the exhibits open to the visitors on March 15 was the Charter Book signed by all fellows.

The most interesting exhibits at the Royal Society's reception were those relating to Priestley himself, gathered together from many sources. Among these were to be seen a letter in French intimating to Priestley that he had been nominated for the National Convention, an honour he wisely and firmly declined; the diploma and seal given to him by the Empress Catherine II of Russia and his Copley medal, presented with such graciousness by Sir John Pringle, who remarked that the Society awarded it to him "as a faithful and unfading testimony of their regard, and of the just sense they have of your merit, and of the persevering industry with which you have promoted the views, and thereby the honour of the Society". The diploma, seal and medal were recently bequeathed to the Society by one of Priestley's great-granddaughters and it was to a great-great-granddaughter, Mrs. Belloc Lowndes, that the Society was indebted for the loan of some of the other exhibits, including the letter referred to. Most of Priestley's books, manuscripts and apparatus were destroyed in the fire at Birmingham in July 1791. Another exhibit of great interest was a series of documents, hitherto unpublished, lent by Lord Lansdowne. Beside the Priestley exhibition, there was also a small collection of documents recalling Pepys's connexion with the Royal Society. During the evening Sir Harold Hartley gave an address on Priestley's work.

The Priestley bicentenary was also commemorated in the provinces and his association with Lancashire, Yorkshire and Warwickshire was recalled by articles in the *Manchester Guardian*, the *Leeds Mercury* and the *Birmingham Mail*. His connexion with Leeds was a very close one, for he was born at Fieldhead, close to the city, he attended Batley Grammar School, and in 1767 became the minister of Mill Hill Unitarian Chapel. On March 11, therefore, the Old Boys' Association of Batley Grammar School had a Priestley commemoration dinner at the Hotel Metropole, Leeds, and on the following day a special service was held in Mill Hill Chapel, which was attended by the Lord Mayor of Leeds, Alderman R. H. Blackburn, and members of the Leeds Philosophical Society. During the course of his sermon, the Rev. W. L. Schroeder, referring to Priestley's statue in the city square, said it was symbolic of Priestley's endeavour to bring the light of truth within the reach of all; adding that though most people thought of Priestley as a man of science, it was more important that he was a minister, all of whose activities were devoted to the glory of God and the happiness of mankind.

The Chemical Society will commemorate the Priestley bicentenary by a special meeting in its rooms at Burlington House, London, W.1, on April 6 at 8 p.m., when papers will be read by Prof. A. N. Meldrum, Sir Philip Hartog and Sir Harold Hartley.

University and Educational Intelligence

CAMBRIDGE.—Mr. W. J. Courtauld has provided the sum of £6,000 for the repair of glasshouses in the Botanic Garden.

Sir Charles S. Sherrington will deliver the Rede lecture at 5 P.M. on May 24. The subject will be "Mechanism and the Brain".

Prof. B. L. Van der Waerden will deliver the Rouse Ball foundation lecture on April 24 at noon. The subject will be "The Aims of Modern Algebra".

It has been recommended that Dr. U. R. Evans be appointed assistant director of research in metallurgy for the period during which he holds the Royal Society Armourers and Braziers' research fellowship in metallurgy; and that the post of assistant in experimental research in crystallography be established in the Department of Mineralogy and Petrology for F. I. G. Rawlins, of Trinity College.

C. C. Hurst, of Trinity College, and A. F. Hallimond, of Pembroke College, have been approved for the degree of Sc.D.

WALES.—The Council has accepted with regret the resignation of Dr. S. Dickinson, assistant lecturer in botany at the University College of South Wales and Monmouthshire, Cardiff, on his appointment as research assistant in mycology in the Department of Agriculture in the University of Cambridge.

WITH the twenty-first volume, recently published, the series of "Methods and Problems of Medical Education" issued by the Rockefeller Foundation of New York is for the time being brought to a close. This series was begun in 1924 and has comprised volumes of articles devoted to descriptions of teaching facilities and methods in the field of medical education. The present volume deals with nursing education and schools of nursing, and several institutions in the United States and Canada, Peiping and Bangkok, are described and illustrated. Articles on nursing education in England, Denmark, Finland, France and Hungary are also included.

BILINGUALISM and the employment as a medium of instruction and examination of a language other than the mother tongue of the student give rise to problems of educational administration in many parts of the British Empire and especially in India. Some of these problems are dealt with in a report recently published by the Government of India, Central Publications Branch, Calcutta (pp. 48, price As. 10 or 1*s*.) on the use of the mother-tongue in the matriculation examination of the University of Bombay. It appears that since 1925, matriculation candidates have been permitted to write either in English or in their mother-tongues their answers in history and in Indian classical languages, and the proportion of candidates who have availed themselves of this option to write their history answers in their mother-tongue has steadily increased from one fifth in 1926 to two thirds in 1931, although more than half of the students in the high schools in the Presidency are receiving instruction in English. An analysis of matriculation results goes to show that those who answered the history papers in their mother tongue as a rule gained higher marks than the others but did badly in English.

Calendar of Nature Topics

The 'Borrowed Days'. The Blackthorn Winter

March 29–31.—The last three days of March are said to be marked by unusually fierce winds, sleet, snow and frost. The legend, widely spread in various forms, is that March borrowed them from April to extend his sway. In a Spanish version quoted by Inwards, a shepherd promised March a lamb if he would temper his winds, but after gaining his point refused to pay over the lamb; in revenge March borrowed three days from April, in which fiercer winds than ever blew. The 'blackthorn winter' comes about the same time; it is said that there are generally some warm days at the end of March or beginning of April which bring the blackthorn into bloom, after which comes a cold period called the 'blackthorn winter'.

Depletion of Nutrient Salts in the Sea

In NATURE of February 25 reference was made in this Calendar to the annual spring outburst of planktonic diatoms in the sea. The growing plants consume nutrient salts—phosphates, nitrogen compounds, silicate, and carbon dioxide—and their removal from solution in the water as the plants increase in abundance may be surprisingly rapid. In 1931, between March 23 and April 22, 81 per cent of the nitrate and 70 per cent of the silicate was removed from the sea in the vicinity of Plymouth. Indeed, chemical analysis of the sea-water affords the readiest means of following the diatom outburst. The annual production of phytoplankton in the whole of the English Channel has been calculated to be at least 115 million metric tons, of which the greater part is formed in a few weeks in the spring. In the Barents Sea the outburst occurs about a month later than in the English Channel. In low latitudes, sunlight is always sufficient to permit of plant growth and nutrient salts do not therefore accumulate sufficiently for a big spring outburst to take place. Where, however, upwelling currents bring nutrient salts from the rich reserves in the ocean depths—as off Cape Verde and along the coast of California—a rich plankton may flourish at other seasons.

Spring Outburst of Spawning in Mollusca

Although a few common British gastropods spawn in autumn and winter—notably *Patella*, *Littorina littorea*, *Buccinum*, *Purpura*, *Trivia arctica*, and certain of the Rissoidæ, by far the larger number breed in spring and summer. In March the marine plankton quite suddenly becomes full of all kinds of gastropod veligers, and eggs are laid in any suitable place. Some time during this month we should find the eggs of *Littorina obtusata* and *Lacuna vincta* laid on the seaweeds between tide marks, and just below low water the egg capsules of *Nassarius* on weeds and Bryozoa, and of turrids on anything available. The nests of *Lamellaria* and of *Trivia monacha* in compound ascidians on the shore are also to be found about this time. In March, too, *Aporrhais pes-pelicani* begins to lay its eggs singly in the sandy mud of the sea floor. These are only a few instances of the general rush of molluscs to begin breeding in this month. Many of them continue to lay all through the spring and summer as well.

In the plankton, an inshore haul in March is usually full of the free-swimming larvæ of *Nassarius*, *Rissoa*, and *Lacuna*. The beautiful little Echinospira larva of *Lamellaria* and *Trivia* with their accessory shells also abound. All these feed upon the microscopic plants and animals to be found at this time in the surface layers of the sea, especially diatoms. There can be no doubt, in fact, that larval molluscs devour a very large part of the annual spring crop of diatoms in our waters.

"The Sea-Blue Bird of March"

Although the kingfisher is traditionally associated with the Halcyon Days, the seven days before and after the winter solstice, a more natural association is with the present month. It is now that it is specially noticeable by the river, partly because March sunshine picks out its brilliance against sombre backgrounds, partly because its movements are still unobscured by foliage, and mainly because the mated birds are busy hunting for nesting sites. It was on March 19 that Mr. R. B. Rivière first noticed the digging of the nest-tunnel of the pair, the habits of which he has recently described (*British Birds*, Feb. 1933, p. 262). The tunnel was completed on March 21, both birds apparently sharing in the excavation, but it was then neglected until March 27, and was finally deserted for an old nesting hole nearby. Egg-laying began on April 27; the parents, sharing incubation, began to sit on May 3 or 4, and on May 23 the hen carried the first food to the nest for the young. The period of incubation therefore occupied about 20 days, and the development of the young, from hatching to flying, 27 days. It was noted that as the young grew they were fed upon larger and larger fish, and these were invariably presented to them head first, the position in which the adults themselves always swallowed their prey. Surely Shelley must have been taking full advantage of the poet's handicap when he described how "I saw two azure halcyons . . . thinning one bright bunch of amber berries."

Opening of the Nesting Season

Each season one species of bird or another, generally the starling, house-sparrow or wood-pigeon, endeavours to break the record of early nesting, but generally speaking, March may be said to mark the opening of the nesting season in Britain. Before the end of the month it might be possible to find the nests of about twenty-six different species, and thereafter with the influx of summer migrants the numbers steadily rise, so that almost a hundred kinds of nests may be found in April. In the latter half of May, nesting activity reaches its climax, and although June also is a favoured month, the numbers begin to show a decline which progresses rapidly through July and brings the normal nesting season to an end in August, when a persistent group of perhaps seven or eight species carry on the last of their series of clutches.

Distribution of Manure

At least one and a quarter million tons of chemical manures are used in Great Britain every year, and by far the greater part of this is applied between mid March and mid May. The actual method of distribution is a matter of some importance, for uneven spreading may involve the crop in local starvation or poisoning as the case may be. Moreover, these irregularities when once established are not readily rectified. Much thought has been given to the construction of manure drills, and comprehensive tests have been conducted from time to time to test the various machines in respect of uniformity of distribution over the surface of the ground. In practice, the drill is usually followed by some cultivating implement the function of which is to mix the fertiliser with the soil so that depth distribution as well as surface distribution is in question.

Until recently, the degree of mixing attained by the various classes of implements was only a matter of conjecture, but an ingenious method has now been devised in Germany to render the particles of manure in the soil directly visible, thus enabling depth distribution studies to be undertaken in soil samples carefully removed from the field. The fertiliser is treated with anthracene before sowing, and after distribution and cultivation the samples are examined in ultra-violet light. By this means it has been found that the newer rotary cultivation gives a more uniform distribution than either the surface working implements or the plough. The extent to which these differences of location of the fertiliser affect the crop has not yet been extensively investigated, although on general grounds thorough incorporation would seem to be desirable, particularly with relatively insoluble manures.

Societies and Academies

London

Royal Society, March 9. J. H. Awbery and E. Griffiths: The heats of combustion of carbon monoxide in oxygen and of nitrous oxide in carbon monoxide at constant pressure. The heat of combustion of carbon monoxide in oxygen is 282,730 joules per mole at 20° C., correct to within 3 parts in 1,000. The heat of reaction when nitrous oxide burns in carbon monoxide is 364,340 joules per mole, correct to 2 or 3 parts in 1,000. From these two results, the heat of formation of nitrogen dioxide at constant atmospheric pressure and at a temperature of 20° C. is found to be 81,610 joules, that is, 19·50 cal.$_{15^\circ}$ per mole. This quantity is determined as the difference between two heats of combustion, which were carried out with the same apparatus used in the same manner for both sets of experiments. R. W. Fenning and F. T. Cotton: A bomb calorimeter determination of the heats of formation of nitrous oxide and carbon dioxide. By means of a bomb calorimeter the heats of reaction of oxygen and nitrous oxide in carbon monoxide and hydrogen respectively were measured. Thus, by difference, two values were obtained for the heat of formation of nitrous oxide. A value for the heat of formation of carbon dioxide from carbon monoxide and oxygen was also obtained. Since the combustion of oxygen in hydrogen formed the calibration process, all the values given are based on the acceptance of 68,320 gm. cal.$_{15^\circ}$ as the heat of formation of water (liquid) at constant pressure and at 25° C. On this basis, the heats of formation of nitrous oxide and carbon dioxide at a constant pressure of 1 atmosphere and at 20° C. were found to be—19·74 ± 0·07 kcal.$_{15^\circ}$, or 82,600 ± 290 international joules, and $67{\cdot}65_5 \pm 0{\cdot}03_5$ kcal.$_{15^\circ}$, or 283,090 ± 150 international joules respectively. A. H. Hughes and E. K. Rideal: On the rate of oxidation of monolayers of unsaturated fatty acids. The method of surface potentials has been employed to study chemical reactions occurring in a unimolecular film; the reactions examined being the oxidation by acidified potassium permanganate of long chain unsaturated aliphatic acids such as oleic acid. The reaction velocity depends on the accessibility of the double bond to the oxidising agent, and decreases markedly on compression of the film. Reaction velocity has been studied as influenced by the position of the double bond in relation to the polar carboxyl headgroup. Autoxidation in a unimolecular film has been observed for the elaeostearic acids, and the effect of hydroquinone as an antioxygen to this reaction has been examined.

Edinburgh

Royal Society, Feb. 6. F. A. E. Crew: A case of non-disjunction in the fowl. An exceptional gold cock, *ex* Light Sussex × Rhode Island Red, when mated to Light Sussex females produced 66 silver males, 2 silver females, 48 gold females and 1 gold male. Cytological examination detected trisomic diploid silver males amongst the progeny. The number of the small autosomes is variable, and the small Y could not be distinguished from these. It was not possible, therefore, to identify any other cytologically exceptional types. The genetical and cytological evidence warrants the conclusion that this exceptional cock is an instance of secondary non-disjunction of the sex-chromosomes. A. C. Stephen: Studies on the Scottish marine fauna—the natural faunistic divisions of the North Sea as shown by the quantitative distribution of the Mollusca. By the changes in the density and identity of the dominant species of molluscs, especially lamellibranchs, the North Sea within the 100 fathom line may be divided into four zones: (*a*) littoral zone extending to about 2 fathoms; (*b*) coastal zone extending to about 20 fathoms in Scottish waters but covering the southern North Sea with the 30 fathom line which lies to the north of the Dogger Bank; (*c*) offshore zone covering much of the remaining area; (*d*) Thyasira and Foraminifera zone occupying a small area in the north-eastern North Sea near the Norwegian Deep. Communities are regarded as special cases of zoning. A. Crichton Mitchell: Diurnal incidence of disturbance in the terrestrial magnetic field. By using as a measure of activity, $(Xr_X + Yr_Y + Zr_Z)/1{,}000$, where X, Y, Z are the force components and r_X, etc., are hourly ranges, it is shown from the records of Eskdalemuir Observatory for 1914–25, that diurnal distributions of activity in the field can be represented as a mixture of two different types. One of these is due to ionisation in an upper layer of the atmosphere, 213 km. high, and is produced by the action of ultra-violet light from the sun. It varies in its time of on-set with the varying time of sunrise at that height. The second is due to ionisation in the Heaviside layer, about 90 km. high, produced by corpuscular streams from the sun. It has a maximum at 10.30 p.m. and does not alter in phase with the season of the year. The height of the upper ionised layer was found to have a seasonal variation of type very similar to that of the amplitude in the second term of the harmonic series representing the diurnal variation of pressure. Louis Herrman and Lancelot Hogben: The intellectual resemblance of twins. The intelligence-quotients of four hundred twin pairs have been determined. The separation of like sex pairs into identical and fraternal classes has been made with the assistance of Stocks's finger-print diagnosis. The correlation coefficients corrected for attenuation by Spearman's formula were found to be: identical pairs, 0·86 ± 0·04; fraternal twins of like sex, 0·48 ± 0·08; fraternal twins of unlike sex, 0·53 ± 0·06. The mean differences for fraternal and identical pairs are in the ratio 2 : 1 in accordance with previous observations by Holzinger and by Tallman. The contribution of genetic differences to the distribution of intelligence within the family is discussed. Sib correlations in this investigation were *found to be significantly lower (0·37) than correlations* for fraternal twins. Other data also point to the significance of birth rank in determining differences of *I.Q.* Ch. Koller and Thelma Townson: Spermatogenesis in *Drosophila obscura*, Fallen. (1) The cytological basis of suppression of crossing-over. Homologous chromosomes associate in pairs during metaphase and anaphase of the spermatogonial division, and this association sometimes results in a fusion of their ends. They enter into prophase of the first meiotic division with their ends already associated. The *X* and *Y* associate at one end, and this association persists through prophase of the first meiotic division.

Paris

Academy of Sciences, Feb. 6 (*C.R.*, 196, 377–447). The president announced the death of M. Mesnager. J. Costantin: Objections to the mycorrhizal theory. Discussion of objections raised to the author's theory of the cause of resistance of sugar-cane to disease produced by altitude. Georges Durand: The stability of rows of vortices. Y. Laure: The combustion pressures in closed vessels of air–benzene mixtures. An account of experiments on the explosion pressures developed in a sphere and three cylinders of different ratios of height to diameter. For a fixed ratio of surface to volume the results differ according to the bomb employed: *varying the ratio of surface* to volume by the introduction of thin metal sheets is unsatisfactory since the results depend on the position of the sheets. V. Dolejšek and Mlle. E. Filčakova: The *M* series of tantalum obtained by means of an ionic tube. Robert Ferber: A purely photographic method for the orthogonal projection on a horizontal plane of topographical plans. R. Titéica: Vibrational spectra and the structure of the molecules of methyl and ethyl alcohols. Measurements of the infra-red spectra of the vapours. P. Le Roux: Study of the pleochroism of Iceland spar in the infra-red spectrum. For the specimens of Iceland spar studied, in the infra-red region between 2·2 μ and 4·4 μ, as soon as the absorption becomes large, it is impossible to admit that it is independent of the direction of propagation of the light. Q. Majorana: The action of a *periodic light beam on metallic sheets*. The conclusions given in an earlier note on the same subject, while in part confirmed; require modification. Mme. Irène Curie and F. Joliot: The conditions of emission of neutrons by the action of α-particles on the light elements. The elements studied were beryllium, boron, lithium, aluminium and fluorine. The nuclei Al^{27} and F^{19} undergo two different modes of transmutation, one with the emission of protons, the other with emission of neutrons. Such a case has not hitherto been observed, since for boron the neutron emission is attributed to B^{11} and that of protons to B^{10}. R. Lespieau and Mlle. B. Gredy: The study of some α-ethylene oxides. A comparison of the Raman spectra for ethylene oxide and some of its derivatives. The characteristic frequency of the ethylene oxide nucleus is about 1,250, which is common to all the spectra. A. Lalande: The freezing points of binary mixtures of ethyl alcohol and ethyl ether. The curve showing the freezing point as a function of the composition has two branches: one corresponds to the separation of solid alcohol, the other probably to a separation of pure ether. No stable molecular complex is indicated. *H. Muraour and G. Aunis: The laws of combustion* of colloidal powders. A. Girard and G. Chaudron: The dissociation of cubic ferric oxide. In microcrystalline mixtures of artificial or natural oxides of iron, X-ray analysis is powerless to detect the presence of the cubic variety: the dissociation curves give more information. P. Demougin: The solubility of gun-cottons. G. Rumeau: Optical antipodes and crystallisation velocities. The non-existence of racemic substances in the liquid state. Georges Fournier and Marcel Guillot: The relation between the absorption of β-rays by organic compounds and the molecular structure of the latter. The results of experiments described show that the deviation between the observed and calculated coefficients of absorption are in direct relation with the chemical constitution of the molecule, especially with the nature of the linkages between the atoms of *carbon B. Bogitch: The reduction and oxidation* of the manganese silicates. Mlle. Caillère: A fibrous sepiolite from Madagascar. Dinca Samuiacas: The influence of the X-rays on the formation of the crystalline germ. C. L. Alexanian: The establishment of the map of anomalies of the vertical component of the earth's magnetic field in the plain of Alsace. M. Chadefaud: The existence of an oriented infra-visible structure of the cytoplasm in Algæ. A. Maige: The physico-chemical heterogeneity of plasts. Louis Gallien: The histological transformations correlative with the sexual cycle in *Polystomum integerrimum*. Mme. Françoise Bloch: Fecondation and maturation of the egg in *Diogenes pugilator*. Etienne Wolff: The topography of first rudiments of the liver, from the study of omphalocephalous fowls. Maurice Lecamp: Transplantations of rudiments of the posterior limbs in *Alytes obstetricans*. *Th. Kofman: The diffusion by the human skin of* visible and ultra-violet radiations. A. Dognon: The action of monochromatic X-rays of varying wavelength on the egg of *Ascaris*. M. Mascré and R. Paris: The action of formol on emulsin and invertin. H. Burgevin: The fixation of atmospheric nitrogen by the bacteria of the Leguminoseæ. A. J. Kluyver and J. C. Hoogerheide: The influence of oxygen on alcoholic fermentation.

Cracow

Polish Academy of Science and Letters, Nov. 7. O. Nikodym: Remarks on a note of N. Nikliborc concerning completely integrable systems of total differential equations. S. Kaczmarz: The homeomorphy of certain spaces. S. Mazurkiewicz and Mlle. H. Szmuszkowiczona: Suites of polynomials. S. Dobinski: The dielectric constant of liquid phosphorus. The data found show that liquid phosphorus contains no dipoles. From a discontinuity in the dielectric constant at 48·6°C., it would appear that liquid phosphorus exists in the form of two distinct modifications. K. Dziewonski, W. Kahl, Mlle. W. Koczorowska and M. A. Wulffsohn:

Syntheses of 4·4-diacenaphthylmethane, of 4·4-diacenaphthylketone and their oxidation derivatives. St. Kreutz: The vicinal faces of topaz. J. S. Ruszkowski: Studies on the evolutive cycle and on the structure of marine cestodes. The evolutive cycle of *Grillotia erinaceus*. J. Walas: The plant associations of 'Babia Góra'.

Dec. 5. St. Banach: Lacunar series. J. Schreier: The plane sections of non-convex surfaces. M. Jezewski: Application of the resonance method to the determination of the dielectric constants of aqueous electrolytes. The method of resonance is liable to numerous errors. The author analyses these sources of error and shows how they can be eliminated. K. Dziewonski, Mlle. M. Dominikowna, L. Galuszkowna and Wl. Muz: Studies in the fluorene series. Syntheses of hydrocarbons and ketones derived from 2-benzylfluorene and 2-benzoylfluorene. Wl. Szafer: A case of anomalous anatomical structure of a pine (*Pinus sylvestris*). F. Rogazinski and Z. Glowczynski: Experimental rickets. Rickets and weakness of the limbs in chicks. A. Moszynski: Description of a new species of oligochæte, *Fridericia Stephensoni*.

Forthcoming Events

Saturday, March 25

Royal Institution, at 3.—Developments in Cinematography: A Display of Films, (2) Colour Films.

Monday, March 27

British Science Guild, at 2.30.—Symposium on "The Utilization of Coal". Speakers: Capt. B. Acworth, S. Lacey, Rear-Admiral W. Scott Hill and A. C. Hardy.

Royal Geographical Society, at 5.30.—The Mount Everest Film of 1922 (Climbing Sections): also an early film on Borneo by Carl Lumholz.

Tuesday, March 28

Royal Aeronautical Society, at 6.30.—Annual General Meeting.

Wednesday, March 29

Chemical Society, at 5.30.—(Faraday Lecture at the Royal Institution, Albemarle Street, W.1).—Prof. P. Debye: "The Relations between Stereochemistry and Physics".

Thursday, March 30

Chemical Society, at 4.—Annual General Meeting. Presidential Address: "The Present Position and the Future of the Chemical Society".

Friday, March 31

Royal Astronomical Society, at 4.30.—Geophysical discussion on "Wave Patterns" to be opened by Sir Gilbert Walker, followed by Dr. Rosenhead, Dr. Vaughan Cornish and Dr. Harold Jeffreys.

Institution of Mechanical Engineers, at 7.—(Informal Meeting: Lantern Lecture.)—L. Ennis: "The Sydney Harbour Bridge".

Royal Institution, at 9.—Sir Frederick Keeble: "The Nitrogen Hunger of the World".

Saturday, April 1

Royal Institution, at 3.—Developments in Cinematography: A Display of Films, (3) Films in Relation to Aeronautical Research.

Official Publications Received

Great Britain and Ireland

National Laboratory of Psychical Research. Bulletin 4: An Account of some Further Experiments with Rudi Schneider; a Minute-by-Minute Record of 27 Séances. By Harry Price. Pp. 199+23 plates. (London: National Laboratory of Psychical Research.) 10*s*. net.

The National Institute of Agricultural Botany. Thirteenth Report and Accounts, 1931–32. Pp. 20. (Cambridge.)

The Economic Proceedings of the Royal Dublin Society. Vol. 2, No. 31: Grass Silage. By C. Boyle and J. J. Ryan. Pp. 515–528. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Proceedings of the Liverpool Geological Society, Session the Seventy-third, 1931–1932. Edited by D. A. Allan. Part 1, Vol. 16. Pp. xii+61. (Liverpool.)

Journal of the Royal Statistical Society. Vol. 96, Part 1. Pp. viii+182. (London: Royal Statistical Society.) 7*s*. 6*d*.

Navy (Health). Statistical Report of the Health of the Navy for the Year 1931. Pp. 148. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

The Quarterly Journal of the Geological Society of London. Vol. 89, Part 1, No. 353, February 28th. Pp. 86. (London: Longmans, Green and Co., Ltd.) 7*s*. 6*d*.

Economic Advisory Council. Severn Barrage Committee Report. Pp. 28. (London: H.M. Stationery Office.) 6*d*. net.

Other Countries

Annual Report of the Indian Central Cotton Committee, Bombay, for the Year ending August 31, 1932. Pp. ii+136. (Bombay.) 2 rupees.

The Indian Lac Research Institute. Bulletin No. 12: Shellac Drying Oil Combinations. By Dr. R. W. Aldis. Pp. 4. (Nankum, Ranchi.) 1.8 rupees.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 90: On the Flow of Water through Tubes. By Daizo Nukiyama. Pp. 233–290+6 plates. 65 sen. No. 91: A New Method of Thickness-Measurement of Metal Films. By Sin Tanaka. Pp. 291–306+plates 7–9. 25 sen. (Tôkyô: Koseikai Publishing House.)

Asiatic Society of Bengal. Annual Report for 1932. Pp. 34. (Calcutta: Asiatic Society of Bengal.)

Department of Agriculture, Sierra Leone. Soil Survey of Sierra Leone. By Dr. F. J. Martin and H. C. Doyne. Pp. 35. (Njala.)

Koninklijk Nederlandsch Meteorologisch Instituut. No. 106a: Ergebnisse Aerologischer Beobachtungen. 20, 1931. Pp. iv+42. 2.50 f. No. 108: Seismische Registrierungen in De Bilt. 18, 1930. Pp. vii+66. 1.00 f. (De Bilt.)

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The Severn Barrage Scheme*

THE long awaited report on the practicability of the proposal for the establishment of a great hydro-electric power generating installation near the mouth of the Severn, to be actuated by the tidal waters of the estuary in conjunction with an impounding dam, generally known as the Severn Barrage Scheme, has, at last, appeared. Interest in the matter may be expected to revive with the publication of the report and especially when the Cabinet pronounces its decision thereon, but much of the keen attention which was excited by the original promulgation of the project has died down during recent years. It was put forward in 1920, in unusually glowing terms, by the Ministry of Transport, and advocated as a means of opening up a "vista little short of a revolution in the industrial life of the West and Midlands of England" and of bringing "within the reach of all classes of the community the blessings of light, purity and power". In political and labour circles, with an enthusiasm, which neglected, perhaps, to take into account the limitations and delays inherent in the realisation of constructional undertakings of great magnitude, it was hailed as a heaven-sent inspiration for the immediate absorption of a large bulk of unemployed labour. These highly coloured expectations have given place to a more sober and reflective outlook.

In the intervening period, the scheme has been receiving careful and painstaking investigation by a Committee of the Economic Advisory Council, of which Lieut.-Col. J. T. C. Moore-Brabazon, M.P., is chairman. The technical features of the project not unnaturally presented a number of complex problems, some of them of quite a novel character. It is claimed in the report that this is the first tidal power scheme of any magnitude to be investigated in any part of the world in which a solution of the problems has been indicated. No reliable judgment, therefore, could be formed on the feasibility of the project, until the whole of the physical conditions and the constructional details had been examined from a strictly scientific and economic point of view. The results of the execution of the work were bound to be too far-reaching and drastic in their repercussions on a variety of important interests for it to be treated otherwise than with the most serious attention. The professional men associated with the deliberations and conclusions of the Committee were Sir John Snell, Sir Basil Mott, Sir H. P. Douglas, Prof. A. H. Gibson, and Mr. T. Shirley Hawkins: these names are a sufficient guarantee that this duty has been faithfully and consistently performed. Theoretical calculations have been supplemented by the operation of models and experimental apparatus of a very elaborate character in an endeavour to arrive at a true picture of the results.

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* Economic Advisory Council. Severn Barrage Committee Report. Pp. 28. (London: H.M. Stationery Office, 1933.) 6*d*. net.

As the outcome of its labours, the Committee has issued a carefully considered verdict on the technical side of the undertaking. Following the lines of the interim report of 1929, the Committee finds that there are no insuperable difficulties, geological or otherwise, in the way of the construction of a barrage, and it indicates a suitable site for the structure at the English Stones, on a line approximately parallel to the existing Severn Tunnel. It states, however, that a power station at the barrage, dependent entirely on tidal action, would not produce electrical energy at a cost which could compete economically with energy generated at selected coal-fired stations. On the other hand, with an auxiliary scheme of water storage, which the Committee has examined for a suggested site in the Wye Valley and finds to be quite practicable, it is considered possible to produce a supply of electrical energy, somewhat less, it is true, than that obtainable from the barrage alone, but still of considerable proportions and adequate to meet one thirteenth of the total likely requirements of the whole country in 1941 (estimated at 21,000 million units) at a cost which would be only two-thirds of that due to generation at equivalent coal-fired stations. This would mean the substantial saving of between a million and a million and a quarter pounds per annum.

The capital sum required for the realisation of this outstanding enterprise is of correspondingly colossal dimensions, remarkable even in these days of Brobdingnagian finance. With auxiliary features—roads, railways and harbour facilities—it is estimated to run to over fifty millions sterling. Moreover, the scheme cannot be conjured into existence by the stroke of a magician's wand: it will take fifteen years of steady and persistent effort, during which it is estimated that the number of men employed on construction and manufacture will increase gradually from 2,000 in the first year to 12,000 in the tenth, thereafter rising rapidly to a maximum of 27,800 in the thirteenth year. The Committee does not anticipate that the work could be commenced before 1937, consequently no effective operation would be realised before 1942. In cases of all major engineering works, a great deal depends on the accuracy of the forecasts of time and outlay. In the present instance, the premises for these forecasts are attended by rather greater uncertainty than usual, and it is of interest to note that the allowance for contingencies in the expenditure is 12½ per cent. Moreover, the rate of interest for loans has been calculated at 4 per cent, although the present market rate for Government guaranteed loans is about 3½ per cent. The Committee wisely emphasises the risk of unforeseen difficulties and the danger that the estimates may prove inadequate.

Not the least important consideration in the investigation, apart from the main object of the scheme—the generation of cheap supplies of electricity—has been the probable physical effect of the construction of a solid barrier across the Severn estuary and the consequent interference with the established regimen of the tidal region and the upland water discharge—an interference which may bring about changes affecting in greater or less degree the navigable approaches to the docks at Avonmouth and the port of Bristol in the seaward portion and the transportation conditions to and from the port of Gloucester above the barrage. This aspect of the matter has been carefully investigated by Prof. A. H. Gibson with the aid of a large scale tidal model in an extended series of experiments, from which it would appear "that a barrage would not injuriously affect navigation *below* the barrage", while, "even without dredging, a barrage would not seriously affect navigation *above* the barrage at any time of the tide, and would appreciably improve it at low water". How far this pronouncement, founded as it is on relatively minute movements of silt-laden salt water in a model on a distorted scale, will go to alleviate or dispel the apprehensions entertained by the authorities of the ports of Bristol and Gloucester, it is difficult to say, but they will undoubtedly require to be convinced in no uncertain way that their important trade interests are not likely to be prejudicially affected by the proposed undertaking. A strong point in support of the general reliability of the model experiments is that they have satisfactorily reproduced the main conditions in the estuary at the present time after a period of operation representing seventy-eight years of past history.

Another matter of public concern is the question of floods, which, in the upper reaches of the Severn, are often of a serious character. Fears have been expressed that control of these visitations would be rendered more difficult by the existence of a barrage. The report states that, on the contrary, the model experiments show that a barrage would provide a means of reducing inundations in times of flood. Prof. Gibson's reports on the operation of the model do not accompany the Committee's Report; they will be awaited with interest for the additional light they will throw on the methods by which these important conclusions have been reached.

Sanitation has not been overlooked, and it is satisfactory to have the assurance that the barrage would not seriously affect the question of sewage disposal. With reference to the auxiliary features of the scheme (docks, roads, railways and other transport facilities), it is pointed out that, in combination with a supply of cheap electricity, they may lead to the establishment of new industrial centres, which, as potential sources of trade, offer the prospect of financial return on the outlay.

The foregoing is a necessarily brief review of the principal conclusions arrived at by the Barrage Committee as a result of prolonged and praiseworthy researches. After pronouncing a favourable opinion on the practicability of the scheme from a technical point of view which is sure to command general professional assent, the Committee is careful with judicial impartiality to direct attention to other considerations of a non-technical character "such as the social, economic and industrial reactions of the scheme upon the district", which lay outside the terms of reference and therefore did not concern the Committee in drawing up its report. These considerations are admittedly of the highest importance and will have to be carefully taken into account before the country can commit itself to an outlay of the magnitude suggested. The prospect of a great augmentation of power at favourable rates of generation is undoubtedly attractive, especially to a community like our own, which is dependent on its industrial output for its livelihood and prosperity, and faced nowadays with the fierce competition of other nationalities. None the less, it is essential to exercise due circumspection before the country embarks on an enterprise which, for good or evil, will leave a permanent impression on its surface and an indelible record in its history.

B. C.

International Economics

The Means to Prosperity. By John Maynard Keynes. Pp. 37. (London: Macmillan and Co., Ltd., 1933.) 1*s.* net.

NOTABLE in themselves, and doubly notable for their appearance in the *Times*, Mr. Keynes's recent articles on "The Means to Prosperity" have now been rounded off by a short introduction and conclusion and republished. Mr. Keynes's thesis in essence is the familiar argument that schemes of capital development or, as he terms it, loan-expenditure, are the only available means for creating employment, stimulating demand, raising prices, and so extricating the world from the present depression. Since loan-expenditure by public and semi-public bodies for housing, transport and similar capital works normally absorbs a large proportion of the activity of the capital goods industries, and since private business will not enlarge its demand for capital goods until *after* prices and turnover have increased and profits have become reasonably assured, Mr. Keynes urges that the loan-expenditure which the present situation demands should be embarked on by Government, first through reversal of the contractionist policy which has prevailed for the past year and a half, and then through the launching of new schemes of needed development.

Such schemes, Mr. Keynes argues, by reducing outlay on the dole and increasing the national income and therefore the yield of taxation, will benefit the Exchequer and stimulate industry generally. Since, however, no country by single-handed efforts can increase the volume of employment sufficiently, and since contradictory policies in various countries would cancel the advantages of expansionist efforts, in order to bring about world recovery fresh loan-expenditure must be undertaken simultaneously in all important countries by international agreement. The difficulties and fears of central banks, and the shortage, outside France and the United States, of internationally acceptable means of payment, would however prevent the expansion of credit which must accompany reviving trade. In order to solve this problem, Mr. Keynes advocates the issue by an international authority of gold notes to a total of 5,000,000,000 dollars which, allocated to each country in appropriate proportions against corresponding gold bonds, would give elbow-room for the growth of credit and the revival of activity.

The framing of an agreed scheme along these lines Mr. Keynes regards as the chief task of the World Economic Conference and the only hope of trade revival; and provided that such agreement can be reached, and that the essential subsidiary measures and steps are taken to end exchange restrictions, lower tariff barriers and generally encourage trade, Mr. Keynes would be prepared to see concurrently a qualified *de facto* return to a controlled gold standard. Mr. Keynes is always on the side of the angels, and once again he offers the inspiriting example of clear scientific thinking in a bemused world. Certain details of his argument—notably the probable cost of providing employment for an unemployed man—may perhaps be questioned. The general soundness of his thesis commands wide assent alike in official and technical circles and amongst the general public; and though before recovery can be finally assured, there must be an international political settlement which will abate fear and restore confidence, a vigorous expansionist policy would itself contribute to a political settlement as well as hasten the revival which must come soon if industrial civilisation is not to crash finally and disintegrate.

War and Post-War Explosives

Explosives: their History, Manufacture, Properties and Tests. By Arthur Marshall. Second edition. Vol. 3. Pp. xiv+286. (London: J. and A. Churchill, 1932.) 42*s*.

MARSHALL'S "Explosives" was first published in 1915 at a time when interest in the subject had been stimulated by the necessity for the production of service explosives on a scale unprecedented in the history of the world. Republished in a second edition in 1917, the addition of new matter, particularly on nitro-aromatic compounds, necessitated its expansion to two volumes. The treatment of the subject suffered from the unavoidable restrictions imposed by the necessity of maintaining secrecy concerning the composition, manufacture, and applications of many of those materials in use as service explosives, which precluded the publication of information obtained during the early years of the War.

In the years immediately following the War, many publications relating to the production of explosives and to investigations of their properties were released from Government and other sources. Foremost among these are "Technical Records of Explosives Supply", compiled by W. McNab, and a number of papers from the Research Department, Woolwich, under the ægis of Sir Robert Robertson. The same was true of Germany, France, and the United States, all publishing information hitherto withheld for military reasons.

The new volume under review embodies a large proportion of this information, also the results of work carried out in the intervening years. It must be regarded as a supplementary volume to the first two, and not as complete in itself. The subject matter is arranged in twelve parts and two appendixes corresponding to those in the first two volumes, the paragraphs having marginal references to the relevant pages in that edition.

The whole work forms a valuable summary of the manufacture and properties of explosives, and has been kept within due bounds by the omission of information concerning those raw materials of the industry, details of which are to be found in other works of reference. It is suggested that the three volumes could with advantage be combined in a single volume printed on a thinner and tougher paper, the supplementary paragraphs being inserted in their appropriate places. Possibly the author and publisher will consider this when a new edition becomes necessary.

The first two parts of the new volume deal with the early development of shell and black powder, the latter formerly of prime importance as a service explosive, but now of minor application, its place having been taken by the modern smokeless propellants and high explosives. In the industrial field, it still survives in various forms as a blasting explosive for use in quarrying and mining operations. It is interesting to note that picric acid in the form of its potassium salt was first prepared by Glauber early in the seventeenth century, but the application of the acid to military purposes was delayed until late in the nineteenth century, when it was adopted in the British service as a high explosive shell-filling under the name of 'lyddite'.

Parts 3–7 are concerned with the chemistry and manufacture of modern types of explosive and of their raw materials, based for the most part on the nitric esters of cellulose and glycerine, and on aromatic nitro-compounds. The manufacture of the acids necessary for the nitration processes has undergone great development since 1914; in Great Britain a rapid expansion took place in the production of 'oleum' by the various modifications of the contact process, and in the manufacture of nitric acid by the traditional method using Chile saltpetre as raw material. In Germany the supplies of sulphur, pyrites, and Chile saltpetre were restricted, and intensive development of alternative raw materials and processes was effected; large quantities of sulphuric acid were made by the decomposition of sulphates such as gypsum and kieserite; nitric acid was produced by the oxidation of ammonia synthesised by the Haber and cyanamide processes. Only in post-War years were synthetic methods of production developed in Great Britain at Billingham. For the concentration of weak sulphuric acid, a product of nitration operations, the Gaillard tower proved to be the most efficient type of plant for handling large and continuous tonnage, but for the intermittent and smaller demands of normal production, the Kessler concentrator still holds its own.

The chemistry of cellulose has undergone considerable revision in the light of X-ray spectrography, and of the work of Haworth and others. The supply of cotton cellulose for the manufacture of 'nitro-cotton' presented no insuperable problem to the Allies during the War, but in the case of the Central Powers early recourse was had to wood as an alternative raw material. Some difficulty was experienced in both cases in obtaining a cellulose of suitable chemical and physical properties, but this was largely overcome by the adoption of controlled methods of preparation in place of the cruder methods formerly used. The nitration and stabilisation processes for the most part followed well-tried methods, which are still in use in slightly modified form. Nitric esters derived from other carbohydrates have been prepared and examined, but on grounds of high cost or poor stability have not displaced those of cellulose and glycerine to any great extent.

In the case of glycerine, an interesting application was made of Pasteur's fermentation process, many thousands of tons of glycerine being produced. Some progress has been made in recent years in the continuous nitration of glycerine, in which greater safety is attained owing to the much smaller quantities of explosive present in the nitrator at any one time as compared with the usual batch-nitration method.

Large quantities of glycol were nitrated during the War in order to conserve glycerine, but only latterly has this become an economic process owing to the fall in the price of glycol. 'Nitroglycol' is now largely used as an ingredient of 'non-freezing' explosives.

Previous to the War, the usual filling for high explosive shell was picric acid, but soon after the outbreak of war it was seen that the supply available was quite inadequate. This led to the adoption of T.N.T. and of mixtures of T.N.T. with ammonium nitrate (amatols) as the main types of filling, and called for the development of new methods of large-scale manufacture. The results of preliminary experiments at the Research Department, Woolwich, were embodied in the design of large factories at Queensferry and elsewhere, the production of T.N.T. finally rising to nearly 100,000 tons per annum. Many improvements were introduced, particularly in the method of purifying the crude explosive. The manufacture of picric acid was also continued and expanded, increased efficiency being obtained by the adoption of continuous methods.

In Germany other nitro-compounds such as hexanitro-diphenylamine and picryl sulphide were used in addition to T.N.T. and picric acid.

The enormous propellant requirements of the army led in Great Britain to the introduction of a new type of cordite designated R.D.B. (Research Department 'B') in which acetone was replaced by a mixture of ether and alcohol as a solvent in manufacture, the raw material for the latter being more readily available than acetone. More recently, propellants have been made in which the use of a volatile solvent is dispensed with, thus eliminating the dangerous and slow process of drying from manufacture.

Part 8 deals with blasting explosives, which are increasingly numerous. During the War large use was made of chlorates and perchlorates to take the place of nitrates. The latter in the form of sodium and ammonium salts are largely used in this type of explosive.

The evolution of methods for the determination of the physical and chemical properties of explosives has made great strides during and since the War; noteworthy among these are the application of Sir J. J. Thomson's piezo-electric method to the measurement of the pressure of explosion, of Hopkinson's pressure bar to the measurement of the pressure and violence of detonation, and of the condenser discharge method to the measurement of the velocity of detonation. On the chemical side, much has been done in devising tests for the detection and measurement of instability, notably the gas evolution test of Farmer, and a number of tests for the measurement of the acidity of the products of instability by the use of electrometric methods, or of suitable indicators.

The final section of the book deals with revised methods for the examination of raw and finished materials, and thermochemical data additional to those in vol. 2 are given in an appendix.

The book is well printed, well indexed, contains few errors or misprints, and can be confidently recommended to all those who are interested in explosives, professionally or otherwise.

R. C. Gale.

The Rayon Industry

Cellulose Acetate: its Manufacture and Applications. By A. G. Lipscomb. Pp. xii + 304. (London: Ernest Benn, Ltd., 1933.) 21*s.* net.

It is difficult to keep closely in touch with the development in those branches of industry which become successful and popular at a particular time, because the technical discoveries are either obscured in the form of patents or explained in special journals which are seen only by the few. Hence it is not until some expert considers it advisable to disclose his knowledge in book form that a general perspective of the subject can be obtained by the outsider. This is particularly true of the cellulose acetate industry and its applications in the form of rayon and elsewhere, and Mr. Lipscomb's effort is sure of a receptive public. It is written from a dual point of view, aiming both at giving a complete account of the manufacture of cellulose acetate from its raw materials, including a full account of the up-to-date methods of making these, and also at summarising the very considerable patent literature: a list of these patents is included in a special index.

The rayon industry has not yet made up its mind whether it should properly belong to the textile or to the chemical industry, or to both. It would be rational merely to make the acetate and spin it, but, on one hand, the processes involved in the recovery for re-use of the chemicals required make it attractive to make these chemicals as well, whilst on the other, there is the temptation to dye and do much else with the rayon, even to the making of dyestuffs. In some quarters the view is gaining ground that it is more economic in this and analogous industries to restrict the number of operations than to enter too far into the chemical industry, except on a large scale.

The book follows normal lines in the treatment: commencing with an historical section, a description of modern views of the structure of cellulose and its acetate follows, after which the practical side is stressed. The details are sufficient to be of material help in initiating and running a factory, the chapter under this heading being clearly written. Nothing that is of interest in connexion with cellulose acetate is omitted, so far as we have been able to judge, and the latest plant for special purposes, such as active carbon for solvent recovery and the Suida process for acetic acid recovery, are adequately described. The book should be of immediate use to all who are active or seek for information in this field.

Some Ancestral Fossil Mammals

British Museum (Natural History). Catalogue of the Pontian Carnivora of Europe in the Department of Geology. By Dr. Guy Ellcock Pilgrim. Pp. vi + 174 + 2 plates. (London: British Museum (Natural History), 1931.) 15*s.*

At the time of publication of Darwin's "Origin of Species", Prof. Albert Gaudry, of Paris, was collecting and studying a large series of remains of fossil mammals from an Upper Miocene or Lower Pliocene freshwater deposit at Pikermi, near Athens, in Greece. He soon recognised that, although the animals represented by his fossils were closely similar to those inhabiting the warmer parts of the Old World at the present day, they differed in several small respects and seemed to include some links between animals which are now very distinct, and others which might be the ancestors of our modern animals. Between 1862 and 1867 he published his results in a classic volume entitled "Animaux fossiles et géologie de l'Attique", which was the first attempt on a large scale to describe and arrange extinct animals from the point of view of an evolutionist. Since Gaudry's pioneer work, nearly similar groups of fossil mammals have been found in Spain, Hungary, Macedonia, the Black Sea region, Persia, Mongolia, eastern China, and India; while apparently contemporaneous deposits in North America have yielded several closely allied genera and species. These mammals constitute the fauna which is now generally known as Pontian, and they include especially numerous individuals of the three-toed horse, *Hipparion*.

For many years Dr. G. E. Pilgrim has studied the Pontian and later fossil mammals in India, and he is at present preparing a descriptive catalogue of the large collections of similar fossils from Pikermi, the island of Samos, and other European localities, which are brought together in the British Museum. The first volume, on the Bovidæ. was published in 1928, and the second volume, on the Carnivora, is now before us.

Dr. Pilgrim's descriptions, of course, are entirely technical, but they are extended by many interesting comparisons which help to make the new facts useful for science. They are illustrated by some good text-figures and two plates. The first section relates to the primitive forerunners of the dogs and bears, which are important among the fossils from Pikermi. The next long section is on the mustelines and otters, which are less differentiated in the Pontian fauna than they are at the present day. Then follow more annectant forms between viverrines and hyænas, besides both ancestral hyænas and true hyænas. The well-known *Hyæna eximia*, from Pikermi and Samos, is represented by many fine specimens, which seem to show that it belongs to the same genus as the spotted hyæna, usually named *Crocuta*. This genus is now known to have ranged as far as eastern China, and it is difficult to determine where it originated. True cats of the genus *Felis* occur, and with them are remains of *Machærodus* and other members of the sabre-toothed group.

Dr. Pilgrim's valuable catalogue is unfortunately marred a little by inadequate editing. There are more misprints than might be expected in a publication of the British Museum; and the statement on p. 142 that in 1857 the Bavarian Academy published its *Abhandlungen* in Vienna is inaccurate. There are several ungrammatical and inelegant expressions, and the text would have been much improved by the omission of redundant words and circumlocutions.

A. S. W.

Short Reviews

The Theory of Knowledge and Existence. By Dr. W. T. Stace. Pp. xii + 456. (Oxford: Clarendon Press; London: Oxford University Press, 1932.) 18*s.* net.

THIS comprehensive attempt to determine the characteristics and purpose of knowledge deserves careful reading. We believe that the author is right in stressing the empirical value of epistemology, though we fail to see why transcendental issues are altogether outside the horizon of the theory of knowledge proper. Adopting the well-known method of building up the world with some primitive elements, Dr. Stace characterises first the universe of the solitary mind, then gives shape to the external world, and finally describes what happens when the solitary mind discovers other minds. After concluding this part of his inquiry, he discusses space-time, mathematics, logic, the categories, and scientific knowledge. Though he purposely avoids the technicalities of these subjects, the author has many pertinent reflections about the issues they imply. To give but one example, in discussing the epistemological aspect of the new theories of matter, he points out that the earlier concept of the nuclear atom, though beyond any possible perception, is not itself unreal, as we can make a logical model of it by means of data supplied from other sources of perceptual knowledge. But the new concept of the 'wavicle' which purports to combine the characteristics of a particle with those of a wave, cannot possibly have any sort of existence, as it possesses contradictory properties. Also, he rightly assumes that when any type of knowledge clashes with logic, it is not logic but our scientific assumptions which must be changed somehow.

The author's views on the character of mathematics are of a more controversial character; for him, mathematical propositions are a necessity derived from logic. The truth or falsity of mathematics means something more than self-consistency; it refers them to reality outside mathematics; and therefore mathematics cannot exist in a world of its own, cut off from concrete things. Mathematics, like all other kinds of knowledge, is tied by the 'given'.

T. G.

Pétroles naturels et artificiels. Par J.-J. Chartrou. (Collection Armand Colin: Section de Chimie, No. 124.) Pp. 206. (Paris: Armand Colin, 1931.) 10.50 francs.

IN view of the rapidly growing importance of petroleum in modern life, M. Chartrou attempts to acquaint the public with the main features of the technique of the industry, which in France has only recently come into prominence. An interesting and readable account is given of the composition and properties of the natural deposits, the character of the soil and geological strata in which they occur, theories as to their origin, methods used in the exploitation, storage, transport, refining and analysis of the different products, their application to industry, together with brief summaries of geographical distribution, regulations imposed by different governments and the dangers associated with the operations. In the last chapter new processes are described which are being developed for the production of synthetic liquid fuels and petroleum substitutes.

A glance through the bibliography shows that the author has consulted mainly French works, though Redwood's treatise and several English and American journals are included. Much information of interest to the general reader has been compressed into a small compass and the result is an attractive volume, well illustrated with clear diagrams of apparatus and plant. The chapter on analysis summarises the methods used in the determination of chemical and physical properties of products, empirical formulæ being given for the calculation of constants. The book should appeal not only to technologists but also to a wider public.

Differential Equations from the Algebraic Standpoint. By Prof. J. F. Ritt. (American Mathematical Society, Colloquium Publications, Vol. 14.) Pp. x + 172. (New York: American Mathematical Society: Cambridge: Bowes and Bowes; Berlin: Hirschwaldsche Buchhandlung; Paris: Albert Blanchard; Milano: Nicola Zanichelli, 1932.) 2.50 dollars.

THIS book gives a connected account of the author's researches on the algebraic side of the theory of differential equations and forms a welcome addition to the literature of the subject, for this aspect of the theory has received little attention hitherto. About four-fifths of the space is devoted to ordinary and the remainder to partial algebraic differential equations, the treatment broadly speaking following the lines laid down by Kronecker and his successors in the theory of algebraic elimination and the general theory of algebraic manifolds, transcendental equations being excluded from consideration.

The first chapter is devoted to the decomposition of a system of ordinary algebraic differential equations into irreducible systems, and the second to the precise formulation of the notion of the general solution of a differential equation and its use in determining the manifold of an irreducible system. The succeeding chapters apply and develop these results, the last two extending them to systems of partial differential equations. The novelty of the point of view adopted and the importance of the results obtained render the book well worthy of the attention of all interested in the theory of differential equations.

First Principles of Television. By A. Dinsdale. Pp. xv + 241 + 38 plates. (London: Chapman and Hall, Ltd., 1932.) 12*s.* 6*d.* net.

IT is no easy matter to write a book on a subject like television which is making rapid progress. There is always the risk that when the work is on the eve of publication some new invention will render part of it antiquated. Something of this nature has occurred in this case. Only a few days before writing the preface, the author attended a demonstration in New York given by U. A. Sanabria, a young experimenter from Chicago, who presented 'close up' pictures on a screen six feet square which were better than anything he had ever seen before. By special neon arcs, special arrangements of holes in the discs and a special amplifier, Sanabria can produce pictures which show an almost complete absence of flicker and the detail of which is quite as good as that provided by the average home cinema. Seaming lines also are very little in evidence. We think it was wise to include in the preface what appears at first sight to be a technical afterthought. Anyone possessing some knowledge of electricity and radio can easily understand this book. We can recommend it to everyone who wants a general knowledge of the first principles of television given in an interesting and easily intelligible form.

Webster's Collegiate Dictionary. Fourth edition of the Merriam Series. Pp. xl + 1222. (London: G. Bell and Sons, Ltd.; Springfield, Mass.: G. and C. Merriam Co., 1932.) 21*s.* net.

FROM the point of view of students of science, technology, etc., we cannot think of a better book of general reference. Besides the normal English words to be expected in a dictionary of this size, there are many scientific, technical, and mythological names which they may have occasion to verify, and most of them are included. In this respect the volume is surprisingly up to date, though there are a few omissions. For example, isotopes and stomates (instead of the older term, stomata), are now familiar terms, yet they do not appear. Also protein has been substituted for proteid, yet the latter term takes precedence in this dictionary and is used throughout, in definitions. These, however, are minor points in an extremely useful reference volume which has clearly involved much care and labour. The book is well bound; but we think a cheaper edition is desirable.

Mental Deficiency Practice: the Procedure for the Ascertainment and Disposal of the Mentally Defective. By Dr. F. C. Shrubsall and A. C. Williams. Pp. vii + 352. (London: University of London Press, Ltd., 1932.) 12*s.* 6*d.* net.

THE subject of mental defect is very slow in coming before the public. So many individuals prefer to repress the subject and not admit its existence. It is, however, a very serious problem and one which so many local authorities have shirked and left in a disgraceful condition. Dr. Shrubsall, who is lecturer in mental deficiency in the University of London, and Dr. Williams, have given us a very useful and practical book in which the procedures for ascertainment and disposal of the mental defective in our midst are set out in a very sensible and clear manner.

The pages devoted to specimen forms and their use should be most helpful to those who may have doubts and difficulties.

Light and Life*

By PROF. N. BOHR, For.Mem.R.S.

THIS revision of the foundations of mechanics, extending to the very question of what may be meant by a physical explanation, has not only been essential, however, for the elucidation of the situation in atomic theory, but has also created a new background for the discussion of the relation of physics to the problems of biology. This must certainly not be taken to mean that in actual atomic phenomena we meet with features which show a closer resemblance to the properties of living organisms than do ordinary physical effects. At first sight, the essentially statistical character of atomic mechanics might even seem difficult to reconcile with an explanation of the marvellously refined organisation, which every living being possesses, and which permits it to implant all the characteristics of its species into a minute germ cell.

We must not forget, however, that the regularities peculiar to atomic processes, which are foreign to causal mechanics and find their place only within the complementary mode of description, are at least as important for the account of the behaviour of living organisms as for the explanation of the specific properties of inorganic matter. Thus, in the carbon assimilation of plants, on which depends largely also the nourishment of animals, we are dealing with a phenomenon for the understanding of which the individuality of photo-chemical processes must undoubtedly be taken into consideration. Likewise, the peculiar stability of atomic structures is clearly exhibited in the characteristic properties of such highly complicated chemical compounds as chlorophyll or hæmoglobin, which play fundamental rôles in plant assimilation and animal respiration.

However, analogies from chemical experience will not, of course, any more than the ancient comparison of life with fire, give a better explanation of living organisms than will the resemblance, often mentioned, between living organisms and such purely mechanical contrivances as clockworks. An understanding of the essential characteristics of living beings must be sought, no doubt, in their peculiar organisation, in which features that may be analysed by the usual mechanics are interwoven with typically atomistic traits in a manner having no counterpart in inorganic matter.

An instructive illustration of the refinement to which this organisation is developed has been obtained through the study of the construction and function of the eye, for which the simplicity of the phenomena of light has again been most helpful. I need not go into details here, but shall just recall how ophthalmology has revealed to us the ideal properties of the human eye as an optical instrument. Indeed, the dimensions of the interference patterns, which on account of the wave nature of light set the limit for the image formation in the eye, practically coincide with the size of such partitions of the retina which have separate nervous connexion with the brain. Moreover, since the absorption of a few light quanta, or perhaps of only a single quantum, on such a retinal partition is sufficient to produce a sight impression, the sensitiveness of the eye may even be said to have reached the limit imposed by the atomic character of the light effects. In both respects, the efficiency of the eye is the same as that of a good telescope or microscope, connected with a suitable amplifier so as to make the individual processes observable. It is true that it is possible by such instruments essentially to increase our powers of observation, but, owing to the very limits imposed by the properties of light, no instrument is imaginable which is more efficient for its purpose than the eye. Now, this ideal refinement of the eye, fully recognised only through the recent development of physics, suggests that other organs also, whether they serve for the reception of information from the surroundings or for the reaction to sense impressions, will exhibit a similar adaptation to their purpose, and that also in these cases the feature of individuality symbolised by the quantum of action, together with some amplifying mechanism, is of decisive importance. That it has not yet been possible to trace the limit in organs other than the eye, depends solely upon the simplicity of light as compared with other physical phenomena.

The recognition of the essential importance of fundamentally atomistic features in the functions of living organisms is by no means sufficient, however, for a comprehensive explanation of biological phenomena. The question at issue, therefore, is whether some fundamental traits are still missing in the analysis of natural phenomena, before we can reach an understanding of life on the basis of physical experience. Quite apart from the practically inexhaustible abundance of biological phenomena, an answer to this question can scarcely be given without an examination of what we may understand by a physical explanation, still more penetrating than that to which the discovery of the quantum of action has already forced us. On one hand, the wonderful features which are constantly revealed in physiological investigations and differ so strikingly from what is known of inorganic matter, have led many biologists to doubt that a real understanding of the nature of life is possible on a purely physical basis. On the other hand, this view, often known as vitalism, scarcely finds its proper expression in the old supposition that a peculiar vital force, quite unknown to physics, governs all organic life. I think we all agree with Newton that the real basis of science is the conviction that Nature under the same conditions will always exhibit the same regularities. Therefore, if we were able to push the analysis of the mechanism of living organisms as far as that of atomic phenomena, we should scarcely expect to find any features differing from the properties of inorganic matter.

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* Continued from p. 423

With this dilemma before us, we must keep in mind, however, that the conditions holding for biological and physical researches are not directly comparable, since the necessity of keeping the object of investigation alive imposes a restriction on the former, which finds no counterpart in the latter. Thus, we should doubtless kill an animal if we tried to carry the investigation of its organs so far that we could describe the rôle played by single atoms in vital functions. In every experiment on living organisms, there must remain an uncertainty as regards the physical conditions to which they are subjected, and the idea suggests itself that the minimal freedom we must allow the organism in this respect is just large enough to permit it, so to say, to hide its ultimate secrets from us. On this view, the existence of life must be considered as an elementary fact that cannot be explained, but must be taken as a starting point in biology, in a similar way as the quantum of action, which appears as an irrational element from the point of view of classical mechanical physics, taken together with the existence of the elementary particles, forms the foundation of atomic physics. The asserted impossibility of a physical or chemical explanation of the function peculiar to life would in this sense be analogous to the insufficiency of the mechanical analysis for the understanding of the stability of atoms.

In tracing this analogy further, however, we must not forget that the problems present essentially different aspects in physics and in biology. While in atomic physics we are primarily interested in the properties of matter in its simplest forms, the complexity of the material systems with which we are concerned in biology is of fundamental significance, since even the most primitive organisms contain a large number of atoms. It is true that the wide field of application of classical mechanics, including our account of the measuring instruments used in atomic physics, depends on the possibility of disregarding largely the complementarity, entailed by the quantum of action, in the description of bodies containing very many atoms. It is typical of biological researches, however, that the external conditions to which any separate atom is subjected can never be controlled in the same manner as in the fundamental experiments of atomic physics. In fact, we cannot even tell which atoms really belong to a living organism, since any vital function is accompanied by an exchange of material, whereby atoms are constantly taken up into and expelled from the organisation which constitutes the living being.

This fundamental difference between physical and biological investigations implies that no well-defined limit can be drawn for the applicability of physical ideas to the phenomena of life, which would correspond to the distinction between the field of causal mechanical description and the proper quantum phenomena in atomic mechanics. However, the limitation which this fact would seem to impose upon the analogy considered will depend essentially upon how we choose to use such words as physics and mechanics. On one hand, the question of the limitation of physics within biology would, of course, lose any meaning, if, in accordance with the original meaning of the word physics, we should understand by it any description of natural phenomena. On the other hand, such a term as atomic mechanics would be misleading, if, as in common language, we should apply the word mechanics only to denote an unambiguous causal description of the phenomena.

I shall not here enter further into these purely logical points, but will only add that the essence of the analogy considered is the typical relation of complementarity existing between the subdivision required by a physical analysis and such characteristic biological phenomena as the self-preservation and the propagation of individuals. It is due to this situation, in fact, that the concept of purpose, which is foreign to mechanical analysis, finds a certain field of application in problems where regard must be taken of the nature of life. In this respect, the rôle which teleological arguments play in biology reminds one of the endeavours, formulated in the correspondence argument, to take the quantum of action into account in a rational manner in atomic physics.

In our discussion of the applicability of mechanical concepts in describing living organisms, we have considered these just as other material objects. I need scarcely emphasise, however, that this attitude, which is characteristic of physiological research, involves no disregard whatsoever of the psychological aspects of life. The recognition of the limitation of mechanical ideas in atomic physics would much rather seem suited to conciliate the apparently contrasting points of view which mark physiology and psychology. Indeed, the necessity of considering the interaction between the measuring instruments and the object under investigation in atomic mechanics corresponds closely to the peculiar difficulties, met with in psychological analyses, which arise from the fact that the mental content is invariably altered when the attention is concentrated on any single feature of it.

It will carry us too far from our subject to enlarge upon this analogy which, when due regard is taken to the special character of biological problems, offers a new starting point for an elucidation of the so-called psycho-physical parallelism. However, in this connexion, I should like to emphasise that the considerations referred to here differ entirely from all attempts at viewing new possibilities for a direct spiritual influence on material phenomena in the limitation set for the causal mode of description in the analysis of atomic phenomena. For example, when it has been suggested that the will might have as its field of activity the regulation of certain atomic processes within the organism, for which on the atomic theory only probability calculations may be set up, we are dealing with a view that is incompatible with the interpretation of the psycho-physical parallelism here indicated. Indeed, from our point of view, the feeling of the freedom of the will must be considered as a trait peculiar to conscious life, the material parallel of which must be sought in organic functions, which permit neither a causal mechanical description nor a physical investigation sufficiently thorough-going for a well-defined application of the statistical laws of atomic mechanics. Without entering into metaphysical speculations, I may perhaps add that any analysis of the very concept of an explanation would, naturally, begin and end with a renunciation as to explaining our own conscious activity.

In conclusion, I wish to emphasise that in none of my remarks have I intended to express any kind of scepticism as to the future development of physical and biological sciences. Such scepticism would, indeed, be far from the mind of a physicist at a time when the very recognition of the limited character of our most fundamental concepts has resulted in such far-reaching developments of our science. Neither has the necessary renunciation as regards an explanation of life itself been a hindrance to the wonderful advances which have been made in recent times in all branches of biology and have, not least, proved so beneficial in the art of medicine. Even if we cannot make a sharp distinction on a physical basis between health and disease, there is, in particular, no room for scepticism as regards the solution of the important problems which occupy this Congress, as long as one does not leave the highroad of progress, that has been followed with so great success ever since the pioneer work of Finsen, and which has as its distinguishing mark the most intimate combination of the study of the medical effects of light treatment with the investigation of its physical aspects.

Food Storage at Low Temperature

SOME of the problems involved in the preservation of food for transport and storage have been discussed by Sir William Hardy in two recent lectures*. The abandonment of the earlier agricultural civilisation by many races for an urban culture required the transportation for long distances of foodstuffs destined for the peoples of the cities. Non-perishable foods such as oil, honey and grain required no special treatment; meat and fish, however, were preserved by drying or curing with salt, and root vegetables for winter use as jams made with honey. It was not until the eighteenth century that the growth of winter vegetables was developed and another hundred years passed before low temperature began to be employed to preserve perishable food in the fresh condition.

The modern period began about fifty years ago, when the first cargo of meat was successfully brought from Australia in the frozen condition. That was made possible by mechanical refrigeration, and, at first, research and invention were occupied in perfecting the machinery, the insulation and the design of cold stores, in wagons or in ships. The properties of the material to be stored were, on the whole, neglected until more recently, when the importance of defining the exact conditions under which the stored foodstuffs survived for the longest time was realised and the science of biological engineering became differentiated from mechanical engineering.

The heavily insulated rooms at the Low Temperature Research Station at Cambridge are cooled by pipe grids through which cold calcium chloride brine is pumped. The first approximation to the required temperature is arrived at by regulating the temperature and rate of flow of the brine. The fine adjustment is made by treating the chamber as an electrically controlled thermostat.

Stored foodstuffs undergo changes in cold storage, the nature of which must be fully understood if the food is to be stored at the optimum temperature and if the store is to function efficiently. Fruit, for example, is alive, consuming oxygen and giving off carbon dioxide and heat. The heat production is greater the higher the temperature and is also increased by disease, for example, fungus rot. A rise of temperature in the store thus sets up vicious circles, with shortening of the storage life of the fruit. In addition to removal of heat from the store, the engineering problems involve the maintenance therein of an atmosphere with a constant content of oxygen, carbon dioxide and water vapour.

A further complication arises from the fact that storage life also varies, under the same conditions, with the earlier history of the fruit. The following variables have been found to affect the storage life of apples: variety, rootstock and age of tree, maturity of fruit on tree, its size and position on the inflorescence, the soil, manuring and climate, and finally orchard sanitation.

The rate of output of carbon dioxide on storage varies with the temperature, but the curves at different temperatures all have the same shape. The output falls continuously while the apple is growing and maturing on the tree. It then rises for a short time after picking and again decreases during the remainder of storage life. The similarity of the curves of output at different temperatures suggests that it must be governed by one factor only. This may be the rate of diffusion of oxygen —not of carbonic acid because it diffuses so much more rapidly—or the semi-permeability of the skin of the fruit to the respiratory gases. During the earlier period of storage the apple is peculiarly susceptible to the injury of internal breakdown; during the later period it is only slightly susceptible to internal breakdown but increasingly liable to attack by fungi. For Bramley's Seedling it has been found that minimum wastage from both these factors occurs at 3° C. which is therefore the optimum temperature for storage of this variety.

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* The Hurter memorial lecture before the Liverpool Section of the Society of Chemical Industry on November 18, 1932 (*Chem. and Ind.*, 52, 45; 1933). The Sir William Trueman Wood lecture before the Royal Society of Arts on February 22, 1933.

Another aspect which must be considered is the fact that apples give off vapours or emanations in minute amounts, which are poisonous to other fruit, one part in about fifty thousand being a toxic dose. The phenomenon has a commercial interest since the emanation tends to quicken the ripening of young apples, so that a colony of apples tends to ripen at the same time.

Meat and fish may be either chilled or frozen. Fruit, of course, unless intended for some secondary process such as jam-making, must not be frozen. Chilling will only delay the growth of moulds or bacteria long enough to give the material a storage life of about 30–40 days. If it cannot be marketed within this time, it is necessary to freeze it. Freezing, however, alters the physical state of the tissues and yet does not abolish all chemical change. Moulds, for example, can grow down to $-7°$ C. and bacteria down to $-3°$ C. Freezing results in the separation of ice within the tissue. It acts therefore as a drying agent by withdrawing water. The proteins of muscle become increasingly insoluble when meat is stored in the frozen state, so that on thawing the product is tough and unpalatable. The rate of change has been found to be greatest at about $-3°$ C. The change is entirely due to freezing and does not occur when the tissue is merely overcooled to this or even a lower temperature.

Detailed study of the changes occurring in muscle in the cold has shown that overcooling to $-4°$ C. does not prevent return to the normal state on thawing. Freezing at this temperature kills the muscle, which becomes opaque, shortened and acid due to the formation of lactic acid. This acid is produced and accumulates even in the frozen state, the rate of accumulation rising to a maximum at about $-2°$ C. The temperature of $-1{\cdot}6°$ C. is critical. When frozen at a higher temperature the muscle can get rid of the excess lactic acid and revert to normal on thawing. Muscles frozen at a lower temperature have lost this power; they are dead on thawing and the acid increases in them as in *rigor mortis*. Thus at $-1{\cdot}6°$ C. the catalysts responsible for the re-synthesis of the lactic acid to glycogen are destroyed. It has also been found that the catalysts responsible for the synthesis of phosphagen are permanently lost at $-2{\cdot}5°$ C. and those concerned in the oxidation of lactic acid at $-3{\cdot}2°$ C.

In conclusion, Sir William Hardy referred to the difficulty of assessing the dietetic value of different foodstuffs. Experiments with human beings, which are costly and difficult, will no doubt give an answer in digestible calories which will be quite decisive, but there is little doubt that the answer in terms of human wellbeing will be indecisive. There are certain properties of foodstuffs, hard to define, which yet play their part in the assessment of the suitability of these foods for human consumption. 'Bloom' in meat is a case in point: it appears to have no obvious relation to digestibility, yet it is inadvisable to dismiss the judgment of the trade expert as devoid of physiological meaning. It is never safe to dismiss the tradition of the practical man as having no scientific basis.

Obituary

DR. H. O. FORBES

DR. HENRY OGG FORBES, who died at Selsey on October 27, 1932, was well known among travellers and naturalists in the latter part of the last century, but his activities had been for many years cut short by constant ill-health and consequent seclusion. The second son of the Rev. Alexander Forbes of Dunblade, Aberdeenshire, he was born on January 30, 1851, and educated at Aberdeen Grammar School and afterwards at the Universities of Aberdeen and Edinburgh. He proposed to enter the medical profession, but owing to the accidental loss of an eye, he abandoned this career, although he had almost completed the necessary examinations.

Forbes's earliest travels were in Portugal where he made biological and geological investigations; but in 1878 he embarked on an expedition to the Far East where he spent five years wandering among the Dutch islands—Java, Sumatra, Banda, Amboina, Timor-Laut, Buru and Timor—making observations and collecting zoological and other material. After his return to England, he published in 1885 his well-known volume: "A Naturalist's Wanderings in the Eastern Archipelago: a Narrative of Travel and Exploration from 1878 to 1883." Mrs. Anna Forbes wrote a book "Insulinde" (1887) giving her experiences of this expedition.

Forbes went to British New Guinea in 1885 and early in 1886 made an expedition inland from Port Moresby, hoping to ascend the Owen Stanley Range. Through no fault of his he was unsuccessful, but he made large botanical and other collections and entered into friendly relations with the Sogeri. Mr. John Douglas, the Administrator, appointed Forbes as the Government representative in the China Straits, and Mr. and Mrs. Forbes arrived at Samarai in June, where they remained until the end of March 1887. Forbes then went to Australia to arrange for another expedition. He left Port Moresby for the interior in October 1887 and again reached the base of the Range, making further geographical and other observations. An account and a map of this unsuccessful attempt to reach the summit of the Owen Stanley Range will be found in the *Scottish Geographical Magazine*, 4, 138, 1888. Sir William Macgregor succeeded in reaching the summit in 1889 and renamed it Mount Victoria; in his account of the expedition he criticised the work of Forbes (*Proc. Roy. Geog. Soc.*, 12, 218; 1898). This led to a reply by Forbes (loc. cit., p. 558), and Coutts Trotter later attempted to reconcile the two accounts (loc. cit., p. 697). Although Forbes visited various parts of New Guinea he did not publish anything about the natives in scientific journals, but he recorded a few notes in his official reports (New Guinea, Further Correspondence, C. 5883, London, 1890).

In 1890, Forbes was appointed director of the Canterbury Museum at Christchurch, New Zealand. During his stay there, he visited the Chatham Islands and made a study of the very interesting extinct birds found in recent deposits in that group. The results of this investigation will be found in a paper published in the *Ibis* for 1893, while his more theoretical views as to the geological history of this island group as deduced by a study of the recent and extinct fauna formed the basis for a paper published in the *Supplementary Papers* of the Royal Geographical Society, for which he received the award of the Gill Memorial.

In 1894, Dr. Forbes was appointed director of the Liverpool Museums, the interests of which he was energetic in promoting, and about this time he made, in company with the late Mr. W. R. Ogilvie-Grant, an expedition to the Island of Socotra, where large collections were made for the British Museum (Natural History) and for the Liverpool Museum; the results of this will be found in the "Natural History of Sokotra and Abd-el-Kuri: a Monograph of the Islands", published in 1903.

Forbes's last expedition was to Peru to investigate the condition of the guano industry and the best means for the conservation of the bird life on which the industry was dependent of the Guano Islands off the coast. This was undertaken on behalf of the Peruvian Government, for which a valuable report was prepared containing a survey of the islands, and suggestions for the most efficient methods of working the deposits.

From the University of Aberdeen, Forbes received an honorary degree of LL.D. He was a fellow of the Royal Geographical Society and of the Zoological Society, as well as of many other learned bodies.

Dr. R. T. A. Innes

Robert Thorburn Ayton Innes was born in Edinburgh and educated in Dublin. In 1879, at the age of seventeen years, he became a fellow of the Royal Astronomical Society. He was married in London and began his career as a double star observer in Sydney, where he soon became of repute among astronomers. Half a dozen years later he deliberately sacrificed his quite considerable material prosperity in order to become temporary clerical assistant to Sir David Gill at the Royal Observatory, Cape of Good Hope, at a salary just one-tenth of his income in New South Wales. No weak, 'Safety First' principle in this sudden plunge but everything he had, wife, family, capital and reputation, risked. In after years it gave Sir David pleasure to record the insatiable appetite of his 'Secretary, Librarian and Accountant' for work, extra work and yet more work.

During these few years Innes used the 18-inch Victoria telescope in an extensive search for double stars, but his main work was in the revision of the Cape Photographic Durchmusterung, in which Gill years earlier had the co-operation of Kapteyn. The importance of the C.P.D. may be judged by the award in 1902 of the gold medal of the Royal Astronomical Society to Kapteyn. In this work and for his observation of variable stars Innes used the 7-inch equatorial by Merz which dated from 1849 and Gill wrote, "This work of Mr. Innes was from first to last a labour of love, carried out by him with conspicuous energy and success." It would be difficult to over-estimate the value of this period of testing when Innes was acquiring the knowledge and experience and habits of methodical industry which procured him in 1903 the unsolicited post of creator of the Transvaal Observatory.

The Boer War emancipated the Dutch of South Africa from the tutelage of President Kruger, and at its conclusion an intellectual awakening demanded the establishment of the Transvaal Observatory, which must surely be regarded as the first fruits of that war. For a time at least, it was intended that this Observatory should be exclusively devoted to meteorology with an indispensable time department. Except as a step-ladder by which to raise himself to higher levels, meteorology, whether theoretical or observational, had no appeal for Innes. "Here," said he, in effect, "is a fine clear sky with steady observational conditions, let me use my telescope without stopping to inquire as to how these conditions arose." His first step upon appointment was the purchase (how, we know not, but probably his family had to endure 'iron rations' for a time) of a 9-inch refractor to be mounted on an equatorial stand borrowed from his benefactor at the Cape. In 1909, after an interval of six years, Innes persuaded the authorities to provide him with funds for a 26-inch refractor—this in itself was a difficult piece of work. It was expected that this worthy instrument would be in use in a couple or three years at the most but here is the tragedy of the life of Innes. For sixteen years he was fretting and chafing at the delay, for his telescope was not erected complete with the object glass fitted until April 1925, only two years and nine months before his retirement at the age of sixty-six years.

Innes's first communication made to the *Monthly Notices of the Royal Astronomical Society* was to correct a computational slip in Laplace. From Sydney there followed two others on the secular perturbations of the orbit of the earth by Mars and by Venus, and by a third on the methods of Gauss. It was from New South Wales too that he published his first discovery of 26 new double stars using a 6-inch equatorial without circles. This result of thirty hours observation, "will prove what a mine of wealth awaits the diligent double-star observer in the southern hemisphere". Prophetic words, for ultimately his own doubles numbered 1,200. Next at the Cape he observed η Argus and in a few years discovered 285 new doubles and published his catalogue of southern double stars. Besides this work he contributed two papers to the *Monthly Notices* on multiple systems, and a very notable communication on Jacobi's 'Nome' as a means of computing elliptic integrals.

At Johannesburg Innes established his well-known Circulars which contain the records of much of his work—but the *Proceedings of the Royal Society of Edinburgh*, *Astronomische Nachrichten*, and *Astronomical Journal* contain papers of value. His interest in celestial mechanics continued unabated but of necessity other subjects demanded and received due attention—to mention a few: Jupiter's Galilean satellites, galactic co-ordinates, variable rotation of the earth, occultations and their reduction by improved methods, continuation and completion of the work of Franklin-Adams, use of blink microscope, the invariable plane of the solar system, a new catalogue of southern double stars, and comet orbits. It was a proud day for Innes when the University of Leyden gave him the D.Sc. (*honoris causa*) and of all his work perhaps his discovery of Proxima Centauri pleased him most.

Innes was a good friend and the wide extent of his generosity is barely suspected. In spite of his advancement, he remained to the end absolutely simple, approachable and unaffected and apparently unaware of the high regard in which he was held. Deeply interested in the work of others, he himself worked until the day of his sudden and quite unexpected death on Monday, March 13.

FRANK ROBBINS.

WE regret to announce the following deaths:

Lieut.-Col. A. W. Alcock, C.I.E., F.R.S., professor of anthropology in the London School of Hygiene and Tropical Medicine and professor of medical zoology in the University of London, from 1919 until 1924, formerly superintendent of the Indian Museum and professor of zoology in the Calcutta Medical College, known for his work on Crustacea and deep-water fishes, on March 24, aged seventy-three years.

Mr. James Groves, an authority on the *Charophyta*, on March 20, aged seventy-five years.

Prof. Friedrich Rinne, formerly professor of mineralogy and petrography in the University of Leipzig, author of many works on crystallography, on March 12, aged seventy years.

Prof. Edwin C. Starks, associate professor of zoology in Stanford University, California, who was a corresponding member of the Zoological Society of London, aged sixty-six years.

Prof. J. Millar Thomson, F.R.S., emeritus professor of chemistry at King's College, London, president of the Institute of Chemistry of Great Britain and Ireland in 1900–3, who was known for his work on the chemistry of ancient glasses, chemistry of pigments, etc., on March 22, aged eighty-four years.

News and Views

Early Man in East Africa

WHILE it is no longer possible on the latest interpretation of the evidence to accept the very high antiquity of Oldoway man, there appears elsewhere in this issue of NATURE (p. 477) a series of reports on the further evidence collected by Dr. Leakey in the spring of last year (not "autumn" as stated inadvertently in our note last week) which points to the early appearance of *Homo sapiens* in East Africa. We publish in full the reports of four committees, each dealing with one aspect of the evidence, presented to, and adopted by, the Royal Anthropological Institute's conference at Cambridge. The material which the committees had before them was derived from deposits at Kanjera and Kanam, two sites, about three miles apart, near Kendu, at the north-east of Victoria Nyanza, an area of old lake-beds, well-known for its fossiliferous deposits. It comprised a part of a femur and fragments of human skulls of three individuals from Kanjera, of which one group formed a skull-cap, and a second permitted a reconstruction of the skull, and of a small fragment of human mandible from Kanam, fossil animal remains, including a considerable proportion (which has been put so high as fifty per cent) of specimens belonging to extinct forms, and two stone industries, one a pebble industry and the other Chellean. It is to be noted that at Kanjera, while the human bones comprising two groups had been washed out by the rains, two fragments of the third group were found *in situ* in association with fossil animal remains and Chellean tools. Further, the Kanam fragment of mandible was found not far from a pre-Chellean stone implement.

IN considering the findings of the committees, it must be borne in mind that the geological evidence, more especially in its stratigraphical aspect, is crucial. Several members of the geological committee have visited the sites personally and concur with Dr. Leakey in his view that after the Kanjera and Kanam deposits had been laid down there was great local tilting and volcanic activity. The committee "does not believe that the [skeletal] fragments can have been introduced into the calcareous deposit at a later date . . . the two fragments said to be found *in situ* belong in fact to the original deposit". The palæontological committee finds that the fragment of human jaw from Kanam was associated with a fossil fauna which justifies its reference to the lower Pleistocene, while the Kanjera fauna "cannot be later than the middle Pleistocene". Thus from these two findings it appears that the human remains are referable on both geological and palæontological grounds to lower and middle Pleistocene dates. As to the character of the human remains, the report of the anatomical committee is not unfavourable to their high antiquity, so far as can be determined by their condition, points out the absence of Neanderthaloid characters, and, while adverting to the abnormal thickness of one of the skulls, sees no feature inconsistent with their inclusion in the type of *Homo sapiens*. On the archæological evidence, the human skeletal remains, thus regarded as within the category of 'modern man', are associated with what for this purpose may be termed a pre-Chellean, and a Chellean industry, which are equated with the cultures of Europe of like character through the Oldoway series. The latter are said to be of equal or somewhat greater antiquity than those with which they are comparable in Western Europe. It is to be noted that, archæologically, the association of the Kanam jaw fragment with a pebble industry assigns it to Oldoway I, a stage earlier than that with which Oldoway man was originally associated—the later phase of Oldoway II.

Control of the Tsetse Fly

ONE of the most terrible scourges of Africa is the disease known as sleeping sickness, which is caused by a trypanosome, a blood-parasite, carried and spread by two species of tsetse fly. Hence there was a large gathering of the fellows at the meeting of the Zoological Society on March 21 to see the film exhibited by Mr. R. W. Harris, who showed what is being done by the Government entomologists to mitigate, if not terminate, the ravages of this insect. Since this war of extermination has to be carried on over millions of square miles, any such campaign might seem hopeless. But it was made manifest that, in so far as Rhodesia is concerned, a considerable measure of success has been attained. This has been done by the use of an ingenious trap devised by Mr. Harris's father, Mr. R. H. T. P. Harris. The trap is made of canvas; box-like in form, and much wider at the top, it is mounted on four legs, keeping it well off the ground. In bulk it is roughly of the size of, say, a small antelope. The flies are not very discriminating, and on sighting this canvas 'stalking-horse' alight on it, and crawl down according to their habit, to reach the shaded under-side, there to suck the blood of their prospective victim. Their exploration is thorough, but fruitless. But presently, they find a long slit through which daylight appears, entering from a special cage at the top. They at once pass through, and upwards, into what they take to be the daylight and freedom beyond. Passing into this light-filled cage they are unable to escape. Enormous heaps of flies were shown which had been taken from this trap. Yet another trap was shown designed to induce the flies to deposit their larvæ therein. Millions of pupæ are taken in this way.

DR. BEVAN joined with Major Austen, who forcefully reviewed the main results of this work at the end of the paper, by deploring the efforts which have been made to control the tsetse fly by killing off big game animals. More than 15,000 head of game in one year were slaughtered to this end. This takes no account of the numbers which died from wounds, owing to the lack of skill of the natives armed for this purpose. This state of affairs has fortunately been stopped, for a period at least, owing to the need for financial economy. It is the more deplorable because, as Major Austen and others have shown, if the very last of the big game animals of Africa was wiped out, sleeping sickness would still remain, since there are numerous small animals which also act as hosts for the trypanosome concerned. Even now, considerable misapprehension exists as to tsetse flies. Commonly one hears of *the* tsetse fly. As a matter of fact there are twenty species, all of which feed on blood. Only some of these depend for their food on game animals. *Glossina palpalis*, carrying *Trypanosoma gambiense* and *G. morsitans*, carrying *Trypanosoma rhodesiense*, are the most formidable of sleeping sickness disseminators. But, as Duke and Swinnerton have shown, in certain circumstances, *G. swynnertoni*, closely allied to *G. morsitans*, may also cause human trypanosomiasis, or sleeping sickness. Dr. Bevan gave a most helpful and interesting summary of what is being done in the suppression of this scourge, and the methods adopted towards that end. It is devoutly to be hoped that his protest against the wholesale slaughter of game, as a means to that end, will now cease, since all the highest authorities agree that even if successful, it would be a futile measure. More than that, as evidence has already shown, it might lead to an aggravation of the evil.

The Kea Parrot

WHETHER or not we may be able to boast 'home-bred' keas depends on an experiment about to be made at the Gardens of the Zoological Society of London. An artificial cave is to be made in the parrot-house to induce, if possible, a pair of these birds to breed, and it may well be successful. The kea parrot of New Zealand was years ago to be found in large numbers. Then, unfortunately, it took to attacking sheep, tearing holes in the back to get at the flesh, with fatal results to the sheep. It was said to do this for the sake of getting at the fat covering the kidneys, but this, obviously, is a statement founded on insufficient knowledge of what this implies. The damage done, as evidence has shown, was grossly exaggerated, and, when inflicted, was due to hunger. It was shown that keas could, and did, exist in numbers, without doing damage in areas where the food supply was constant, although in and around sheep-farms. But be this as it may, the fear and dislike which its presence has engendered, threatens its existence. Hence it is to be hoped the experiment of the Zoological Society will be successful.

Alcohol-Petrol as a Motor Fuel

IN connexion with the leading article in NATURE of March 11 on the subject of power alcohol, it is of interest to find that an alcohol-petrol mixture has begun to be distributed in Great Britain from garages over a wide and extending area under the name of "Koolmotor Alcohol Blend" at the same price per gallon as No. 1 Petrol. A mixture of alcohol in petrol has been in common use in racing cars for a year or two, but now the ordinary public will have for the first time an opportunity of testing its merits, in particular the absence of knocking. The anti-knock value is said to be equivalent to approximately 85 octane number. An alcohol of 99·9 per cent purity produced in England is being used. It is probable that the use of a fuel of this type in England, with the opportunity it will give for general experimenting, will have an effect on engine design. As the result of motor racing, which has as its real object the improvement of design and not the establishing of speed records, engines of high compression ratios have been introduced which need special fuels if they are to be used to advantage.

A BLEND of alcohol with ordinary petrol has now been prescribed by law in Czechoslovakia. Science Service of Washington, D.C., gives details of the spirit, 20 per cent alcohol and 80 per cent petrol, which the Government has apparently instigated in order to give a boost to the potato industry. Potato starch yields the desired grade of alcohol by hydrolysis and fermentation and all motor fuel is, apparently, to be treated with the specified percentage of alcohol before retail sale. There is, further, one technical matter which seems to have been solved in this connexion. Alcohol, as produced by economical distillation methods, usually carries with it 4–6 per cent water, which makes it impossible to mix directly with straight-run petrol, particularly of the paraffin base type. Recent research has resulted in a new distillation process, economical on a large scale, which permits dry or 'absolute' alcohol to be made with the aid of benzene. This product is now available under the new Czechoslovakian edict. The somewhat curious corollary to all this is that ordinary petrol will now go on the restricted list in that country, like ethyl and methyl alcohol in Great Britain, and, presumably, only chemists, research laboratories and the like will be able to receive permits to purchase pure petrol.

Darwin's Barometer

THE British Association has recently received on loan from the Royal Society the barometer used by Charles Darwin during the voyage of the *Beagle*, and it is now exhibited among the other relics of Darwin in Down House, his home in Kent, now in the custody of the Association. The barometer, made originally by the firm of Newton, has been restored by Messrs. Negretti and Zambra with the advice of the Meteorological Office, the scales have been re-engraved, and it is now in working order as Darwin had it. The instrument is of the straight type, contained in a wooden case three feet long, with a thermometer near the base. The barometer scale reads down to 18·2 in., so it was suitable for use up to fairly high altitudes, and Darwin is known to have carried it when ashore during the voyage. A double mercury cistern and locking arrangement is provided to allow of carrying the instrument without disturbance.

British Polar Year Expedition

THE National Polar Year Committee has received a report dated December 31, 1932 from Mr. J. M. Stagg, leader of the British expedition at Fort Rae in Canada. From this it appears that the party had its first taste of winter conditions on October 1, when the first snow fell and the rain recorder was permanently frozen up. The temperature at the date of the report was about −40° F. Difficulties have also been experienced with the clocks. Special low temperature clocks proved useless out of doors, but the party found that by removing all the oil from ordinary clocks, they functioned satisfactorily. The recording pen of the anemograph has also proved troublesome. Sounding balloons have been sent up but none had been recovered, though a cabled message has since reported the recovery of two meteorographs with good records. Communication with the sub-station for auroral photography about twenty miles south-east of Fort Rae was by wireless, but with the onset of winter, a telephone line was taken across the frozen Great Slave Lake. Auroral activity has been poor though some form of aurora can be observed more or less continuously from dusk until dawn. Some four hundred photographs have been taken, using the double station communication to obtain simultaneous exposures at Fort Rae and the sub-station twenty miles distant. The moon is only below the horizon for a short time daily, and during full moon auroral photography becomes almost impracticable. The sub-station is manned by one member of the expedition for a week at a time. The expedition's schedule includes full meteorological records every three hours, hourly cloud observations, and observations of aurora every five minutes and continuously when photography is being done.

Recent Acquisitions of the British Museum (Natural History)

ADDITIONS to the study series of mammals in the Zoological Department of the Museum include the skins of a male and female golden cat (*Profelis aurata*) from the Cameroons, presented by Mr. F. W. Carpenter. The specimens illustrate the two colour phases found in this species, one skin being buff and the other grey. A similar dimorphism exists in the bay cat of Asia, and at one time the buff-coloured specimens were thought to represent a species distinct from the grey ones. The Department of Entomology has received during the past twelve months a further 7,773 insects collected and presented by Mr. Rowland Turner, from South Africa. Most of these are small and little-known wasps, and the proportion new to science is extremely high. The Department of Mineralogy has acquired by exchange fragments of a meteoric stone which fell on August 27, 1931, near Yukan in eastern Kiangsi, China. Although the fall of stones from the sky has been mentioned in Chinese literature since 1808 B.C., none appears to have been preserved with the exception of three stones that have been described scientifically since 1923.

Botanical Acquisitions at the Natural History Museum

His Majesty the King has placed on loan a further collection of Nepal plants presented to him by His Highness the Maharaja of Nepal. The collection contains 182 specimens and was made in central Nepal by Prof. K. N. Sharma. The plants are excellently preserved, and include a fine series of *Primula, Gentiana* and *Mecanopsis.* Seeds of most of the plants have been sent for growing in the Royal Parks and Gardens. The British herbarium of the late Mr. Percy Moring has been presented by his widow. Mr. Moring was resident for some time at Dover and the herbarium is rich in plants of the neighbourhood. It also contains the specimens collected round Hampstead during the Hampstead Regional Survey. Many specimens from the London suburbs are valuable records of habitats now lost through building. The Department has purchased Part I of a copy of an edition of Philip Miller's "Figures of Plants described in the Gardener's Dictionary", published in 1798. So far, nothing is known further about this edition. The thirty plates are printed in various colours and are also coloured; the dates have been erased from the blocks and the Linnean system of naming has been adopted.

A British Film Institute

The joint committee of the Commission on Educational and Cultural Films and the bodies representing the film trade has now reached agreement on a scheme for the setting up of a British Film Institute. The general purpose of this Institute will be to encourage the use and development of the cinematograph as a means of entertainment and instruction. Among its specific objects will be to advise educational institutions and other organisations and persons as to sources and conditions of supply, types of films and apparatus; to promote and undertake research into the various uses of the film and of allied visual and auditory apparatus; and to maintain a national repository of films of permanent value. The Institute will have a membership based on subscription, and its government will be vested in a council representative in equal proportions of the film trade, educational interests and the general public. The membership of the governing council has not yet been completed, but it includes Sir Charles Cleland, Mr. A. C. Cameron and Mr. R. S. Lambert as representing the Commission on Educational and Cultural Films and Mr. Thomas Ormiston, M.P., Mr. C. M. Woolf and Mr. S. Eckman, as representing the film trade.

Underground Lighting in Mines

The paper on "Underground Lighting in Mines" read to the South Wales Branch of the Association of Mining Engineers by R. H. Campin and published in the *Mining Electrical Engineer* for February is a helpful and useful paper. Special stress is laid on the importance of miners' hand lamps. Mr. Campin points out that most of the hand lamps now in use are virtually of the same type as those developed before 1915. There are approximately 750 thousand hand-lamps in use in Great Britain. About fifty per cent of them are flame safety lamps. The popularity of the flame type is probably due to the fact that it automatically indicates the presence of inflammable gas. Most of the electric lamps in use are of a somewhat antiquated type giving only one candle power and supplied by a two volt battery in a celluloid case. The number of lamps supplied by alkaline batteries is about four per cent. There is no doubt that in many cases improved lighting would considerably increase the output as well as diminish the total number of accidents per annum on which compensation has at present to be paid. The author mentions the case of a German mine where the effect of doubling the illumination was to increase the output per man-shift by about 30 per cent. Doubling the light increased the cost of the lighting from a halfpenny to a penny per ton of coal raised. Medical investigations have shown that nystagmus is practically a light deficiency disease. The collieries have to spend £440,000 annually in compensation to sufferers from it. If lights of not less than four candle power were used, the number of cases would be greatly diminished. The author thinks that the illumination of many of our collieries could be tripled or even quadrupled without increasing operating charges. Flood-lighting at localised spots is recommended.

Prehistoric Society of East Anglia

The contents of the recent issue of the *Proceedings of the Prehistoric Society of East Anglia* (vol. 7, pt. 1) are of exceptional interest. At the head is the presidential address in which Mr. J. Reid Moir surveys the evidence for the culture of Pliocene man which has been collected in the last twenty-five years. This is followed by a description by Mr. J. P. T. Burchell of hand-axes from the north of Ireland, upon which Mr. Reid Moir reports that a certain number are undoubtedly of high antiquity, ranging from eolithic to Clactonian I. Lieut. K. R. W. Todd enumerates stone age sites, mostly palæolithic, from which he has obtained a considerable number of implements, in the neighbourhood of Bombay; and Prof. A. Barnes discusses the mode of prehension of some forms of upper palæolithic implements. The important work of exploration at Grimes' Graves has been continued and Mr. Leslie Armstrong reports on the examination of five pits, one still unfinished, since the date of the last report in 1926. Two communications deal with different aspects of related problems. Of these, one by Mr. Stuart Piggott and Prof. Gordon Childe describes and discusses the affinities of neolithic pottery from Larne, now in the Ashmolean Museum. The authors conclude that in decoration this pottery is a reflex of the current round the north of the British Isles that is supposed to have brought the passage-grave idea to Denmark, while in form it is the most distinctively Iberian in the whole Windmill industry. In the second communication, Mr. J. G. D. Clark examines the distribution of the curved flint sickle blade in Britain, and deriving it from the Nordic culture area, thinks it is to be associated with the Peterborough pottery folk, while it is probable that the Windmill Hill people used a composite sickle. In addition to other communications, there are some useful notes and references.

Barrages on the Niger

One of the most important irrigation schemes in the African Sudan is being carried out in the Upper Senegal district of French West Africa, where the project is to irrigate the Macina district from the flood waters of the Niger. A few details are given in *Terre Air Mer* for February. At Bamako the Sotuba barrage, 1,340 yards long, irrigates about 15,000 acres on the right bank. The chief barrage, however, is in course of construction below Segu about 200 miles farther downstream at Diamarabougu. This will be about 1,300 yards long and will feed a number of canals on the left of the river. Some of these are already cut and embanked. A navigation canal with locks will be built round this barrage. It is estimated that this irrigation scheme will eventually allow the population of the area affected to be increased five-fold with crops of rice, cotton, forage plants and live-stock.

Sir Patrick Geddes

A supplement issued with the recent number of the *Sociological Review* (vol. 24, No. 3) consists of tributes to the late Sir Patrick Geddes by friends, former pupils and fellow-workers, in which his many-sided genius, his fertility in ideas and his gift for inspiring enthusiasm in others are commemorated. Sir D. M. Stevenson, Lord Provost of Glasgow, writes of "the Social Reformer"; Mr. Edward McGegan, writing from the Outlook Tower, Edinburgh, with which the name of Geddes will always be associated, speaks of him as a man of action; Lord Sandwich records his part in the saving and re-erection of Crosby Hall; Dr. R. S. Buist tells of his work at University College, Dundee; while intimate views of his enthusiasms, with which he fired others, are given in accounts of his schemes for forming a university students' quarter in London, of his work in town planning in India and in Palestine and his Collège des Ecossais at Montpellier, by writers who were closely associated with him in these undertakings.

Moles Storing Worms

Referring to notes in our Calendar of Nature Topics of Feb. 25, Mr. Lionel E. Adams, Wheatley, Shide Cross, Newport, I.O.W., who contributed a valuable paper entitled "Observations on a Captive Mole" to the *Proceedings of the Manchester Literary and Philosophical Society* of May 31, 1906, and later, an illustrated article entitled "Moles and Molehills" to Nature of March 10, 1910, p. 37, writes: "A farmer on whose land I was trapping moles, informed me that while digging out a 'fortress' he came across a mass of dead worms in the nest cavity close to the nest. He described the quantity as 'three spadefuls'. I have frequently watched captive moles bury worms when their hunger was satisfied. The mole would bite the worm with quick bites along its whole length and then cram it into the earth and scratch the earth over it with his fore paws."

Australian Entomology

Amongst many valuable references to papers in all branches of science, *Australian Science Abstracts* (No. 4, Nov. 1932) records a "Bibliography of Australian Entomology, 1775–1930", published by the Royal Zoological Society of New South Wales (1932, pp. 1–380). In the list of papers and works touching on Australian insects during that period are references to scientific expeditions which have visited Australia and information concerning authors, collectors and collections. Invaluable to entomologists, the work will be found useful also by zoologists and botanists. An index classifies papers written on various orders of insects, as well as papers on economic, medical and veterinary entomology, and on Australian fossil insects.

The Faraday House Journal

The part played by the Faraday House Electrical Engineering College in providing Great Britain with electrical engineers has been a very important one. Its old students are found occupying many of the highest positions in the electrical industry, and the recent issue of the *Faraday House Journal* states that more than 2,000 students have passed through the College. The virtual founder of the College was Robert Hammond, who in 1882 opened the Hammond Electrical Engineering College. In one of the notes in the *Journal* reference is made to the attempt to light Cockermouth with electricity in 1881, the opening function being attended by Hammond. That same year Godalming was lighted by electricity, but whereas this proved successful the scheme at Cockermouth failed. The *West Cumberland Times*, however, looking ahead, said that electricity would revolutionise the world, that the maturing of fruits and vegetables would be speeded up by its use and that the dynamo would be as common on the farm as the threshing machine.

The Ray Society

At the annual general meeting of the Ray Society, held on March 22, the following officers were re-elected: *President*, Sir Sidney Harmer; *Treasurer*, Sir David Prain; *Secretary*, Dr. W. T. Calman.

Mr. Charles Oldham was elected a vice-president and Mr. D. J. Scourfield, Mr. J. Spedan Lewis and Mr. David Bryce were elected new members of council. It was announced that the third volume of Dr. Gurney's "British Freshwater Copepoda" is in the press, and will form the issue for the current year. For future issue, in addition to the second volume of Prof. Stephenson's "British Sea Anemones", the Council has provisionally accepted works on British Neuroptera by Mr. F. J. Killington, on British Psocoptera by Mr. J. V. Pearman, and on British Freshwater Planarians by Mr. Philip Ullyott, all of which are in active preparation.

Announcements

At the annual general meeting of the Institute of Metals, the following officers were elected for the year 1933–34: *President*: Sir Henry Fowler; *Vice-Presidents*: Prof. C. H. Desch and Prof. R. S. Hutton; *Members of Council*: Eng. Vice-Admiral Sir Robert Dixon, Mr. Wesley Lambert, Mr. H. C. Lancaster, Mr. A. H. Mundey, Mr. A. J. G. Smout, Mr. F. Tomlinson. The silver Jubilee meeting of the Institute will be held in Birmingham on September 18–21. It was in Birmingham that the first general meeting of the Institute was held in the autumn of 1908, under the presidency of the late Sir William White.

The Institute of Physics announces that the B.O.I.M.A. Prize for the best paper published in the *Journal of Scientific Instruments* during the year 1932 has been awarded to Mr. E. Lancaster-Jones, of the Science Museum, for his paper on "The Principles and Practice of the Gravity Gradiometer", and the Institute of Physics prize for the best contribution to the Laboratory and Workshop Notes in the *Journal* has been awarded to Dr. J. L. Miller and Mr. J. E. L. Robinson of Messrs. Ferranti, Ltd., for their joint note entitled "A Three-Dimensional Adjustment of an Electrode in Vacuo".

A special exhibition in commemoration of the death, on April 22, 1833, of Richard Trevithick, the great advocate of the high-pressure steam engine and the 'father' of the railway locomotive, is being held in the Main Hall of the Science Museum, South Kensington, from March 31 until the end of June. The exhibition includes examples of engines, etc., designed by him as well as numerous other objects relating to him and his work.

The fourth annual exhibition of television and photoelectric apparatus arranged by the Television Society will be held at the Imperial College of Science and Technology, South Kensington, S.W.7 on April 5 at 6–9 p.m. and April 6 at 3–9 p.m. The exhibition catalogue (price 6*d*., or post paid, 7*d*.) can be obtained on about April 3 from the exhibition secretary, Mr. W. G. W. Mitchell, "Lynton", Newbury, Berks. Further information and cards of admission can be obtained from the honorary business secretary of the Television Society, Mr. J. J. Denton, 25, Lisburne Road, Hampstead, N.W.3.

We have received from British Glues and Chemicals Ltd., Imperial House, 15, 17, 19 Kingsway, London, W.C.2, a pamphlet containing particulars of an international competition organised with the object of promoting interest and research in the development of the uses of bone glue. Provision has been made for prizes to the total value of 20,000 Swiss francs and a further sum of 10,000 Swiss francs is held in reserve to be employed in special cases set out in the rules. A copy of the pamphlet containing the rules and any further information may be obtained at the above address (Department I/S).

In the review of Dr. W. N. Bond's "Numerical Examples in Physics" in Nature of March 4, the reviewer suggested that it was a slip on the part of the author to express the mass of the sun as 1·47 kilometres, and to specify a piece of glass as having a refractive index of 1·961. Lord Holden has written to point out that the former is a statement in terms of units that Eddington has found it convenient to use. It may therefore be regarded as correct but rather cryptic. As regards the second statement, glass has been made of such a large refractive index as is given in the question, though it is not very satisfactory in use, turning yellow with age. The high value of the refractive index was intended by Dr. Bond to add point to the numerical example.

Applications are invited for the following appointments, on or before the dates mentioned:—Three *junior assistants in the Chief Engineer's Department* of the Metropolitan Water Board—The Chief Engineer, Offices of the Board, 173, Rosebery Avenue, E.C.1 (April 6). A temporary principal technical assistant in the Shellfish Services Staff and an assistant naturalist in the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 (April 10). Examiners in botany and mathematics in the matriculation and General School examination of the University of London—The Secretary to the Matriculation and School Examination's Council, University of London, South Kensington, S.W.7 (April 18). A professor of physiology in the University of Sheffield—The Registrar (April 20). A senior pathologist in the Department of Preventive Medicine of the University of Bristol—The Secretary (April 20). A scientific assistant in the Imperial Bureau of Plant Genetics: Herbage Plants, Agricultural Buildings, Aberystwyth, Wales—The Director (April 21). A demonstrator in the Department of Zoology at Bedford College for Women, Regent's Park, N.W.1—The Secretary (April 29). An inspector of installations (heating, ventilating, electrical, sanitary, etc.) for the new buildings of the Société des Nations—Le Bureau du Personnel, Secrétariat Société des Nations, Geneva (April 30). A lecturer in helminthology in the Department of Zoology and the Royal (Dick) Veterinary College (University of Edinburgh)—The Secretary of the University (May 24).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Protective Inoculation against a Plant Virus

The *X* virus of the potato, first described by Kenneth Smith[1], is capable of considerable variation in virulence, as shown by its clinical expression on several of the Solanaceæ. If tobacco plants be inoculated from the potato and the virus maintained by *passage* over a long period, the clinical expression may pass from a more or less mild mottling of pale and dark green, to a stage in which the pale areas are bright yellow, ending in one in which the lesions become extensively necrotic. Inoculation with the virus in this latter stage causes young tobacco plants to remain in a dwarfed and crippled condition.

Some four months ago, a series of experiments was instituted in which segments of about 2 mm. diameter were punched out of the green and yellow areas respectively of a leaf of a somewhat severely affected *X*-infected tobacco plant of the White Burley variety, and inoculated by needle into young and healthy seedlings of the same variety. It was at once evident that two distinct clinical conditions had ensued. From the green areas there resulted an exceedingly mild disease we may designate the *G* type of *X*, from the yellow areas a severe disease with large bright yellow patches on a pale green background accompanied by dwarfing; we may designate this the *L* type of *X*. So far, no further development of virulence has occurred in this type, although the *G* strain has, by selective sub-culture, been reduced to one giving an almost imperceptible reaction. Mixing the *G* and *L* tissue extracts in varying proportions *in vitro*, and inoculating tobacco seedlings with the same, has shown that a mixture of 1 *L* : 9 *G* produces a preponderantly *G* reaction, whilst mixtures with less of the *G* element call forth a reaction like that of *L*. Although plants infected with a 1 *L* : 9 *G*, or a 1 *L* : 19 *G* mixture behave, in general, like *G* infections, yet small areas of bright yellow, such as is common in the *L* type, do appear scattered on the otherwise almost normal green leaf. Sub-cultures from such yellow and green areas respectively, in these mixed infections, reproduce the original *L* and *G* types. There has been mixture of the two strains, not neutralisation of one strain by the other.

If tobacco plants inoculated with the mildest type of the *G* form of the *X* virus—no matter whether the ensuing reaction is definite enough to be recognised as a mottle, or so slight as merely to arouse a suspicion of its presence—are re-inoculated after nine days, either with the *L* strain or the most virulent necrotic type of *X* we possess, no further reaction ensues. Such plants retain their mild, almost imperceptible, *G* type of reaction, and present a solid immunity against the further attack of the *X* virus however virulent it may be. Later experiments have shown that this protection against the virulent strains of *X* is developed on the fifth day after the preliminary inoculation, and some four to five days before any systemic response to *G* is apparent. When from such doubly inoculated plants sub-cultures are made, only the *G* type of the *X* virus is obtained; the secondarily inoculated and severer type has failed to gain an entry. It would appear that once the plant cell has formed a symbiotic union with the non-virulent form, it has no capacity to enter into relations with any other virus elements of the same generic type.

The reactions recorded above have been repeated on *Datura strammonium*: in this species both the *L* and the necrotic forms of *X* produce a deadly effect. It is, however, only necessary to give the *Datura* plants a preliminary dose of the *G* form of the *X* virus, which induces but a mild mottle with little or no hindrance to growth, and subsequent inoculation a week later with the most severe *X* virus is without effect.

The protection afforded by the *G* strain holds good also for Miss Hamilton's[2] Hy IV, an *X* type of virus discovered in field crops of *Hyoscyamus*, but it is powerless against the *Y* potato virus of Kenneth Smith[1], as well as against that of the common tobacco mosaic, Johnson's No. 1.

The green 'veinbanding' islets, a late development on the leaves of tobaccos infected with the *Y* virus, have been examined by the same methods but with different results. Here neither evidence of a mild or symptomless *G* form, nor that of any adequate protective mechanism, has as yet been found. Indeed the central portions of such green islets appear to be free of virus. A similar condition was shown by Storey and McClean[3] to exist in streak-infected maize. How such green areas, surrounded by a solid mass of heavily infected cells, retain their freedom from virus, is a problem distinct from that of the corresponding areas in the *X*-infected plant.

Within the limits of this communication it is not possible to do more than refer very briefly to the results of others. McKinney[4] differentiated green and yellow strains in rosette disease of wheat, as has been done here with the *X* virus. Both Price[5] and Thung[6] have recorded observations which suggest a similar type of immunity. The phenomenon here described is, however, distinct from theirs, inasmuch as the protection afforded is achieved by a preliminary inoculation of a virus with an almost subliminal virulence, with the result that neither protective nor subsequent inoculation has any appreciable effect on the health of the plant.

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March 6.

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[2] Hamilton, M., *Ann. App. Biol.*, 19, 550; 1932.
[3] Storey and McClean, *Ann. App. Biol.*, 17, 691; 1930.
[4] McKinney, H., *Science*, N.S., 73, 650; 1931.
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[6] Thung, T. H., reviewed in R. A. M., 11, 750; 1931.

Experimental Rickets as a Phosphorus Deficiency Disease

Although both prophylactic and curative technique against rickets is now highly developed, the pathogenesis of the disease is still far from being adequately understood. Recent experimental findings—some having already been published[1], others to be published shortly—are briefly summarised here since they afford, it would seem, strong support for the view that, whilst other factors play a part, and it would be idle to endeavour to dissociate phosphorus from calcium metabolism, yet nevertheless *a chronic defect of phosphorus uptake from the diet* is the most important single factor in the production of experimental rickets in rats. This is very probably true in a large proportion of cases of human rickets also, vitamin D being of importance in the rat or human dietary only in so far as its presence enables the organism to increase the net intestinal absorption of phosphorus from the food. Our findings also throw a little light, it is believed, on the part played by the bone enzyme in this disease.

(*a*) We have found that on a normal stock diet, (Bills's[2]) with or without extra vitamin D in the form of irradiated ergosterol or cod liver oil, very severe rickets, demonstrated by X-ray photographs, by the histological appearance of sections of the long bones and by bone ash and plasma phosphate analyses, may be brought about in growing rats by the simple expedient of adding 0·5 per cent of *beryllium carbonate* to this normal diet. With smaller quantities of the carbonate down to 0·1 per cent or even less, a milder rickets may be produced, amenable in some degree to therapy with the usual antirachitic agents. The addition of an equivalent quantity of beryllium *phosphate* to the Bills's diet has no such effect, and the rats continue to grow normally.

Beryllium is peculiar in forming a phosphate which is highly insoluble even in fairly acid solutions (*p*H4 or less). Its rachitogenic effect is almost certainly bound up with this property, the beryllium dissolved in the gastric juice precipitating quantitatively in the intestine with any free phosphate found there, whether derived from the food or from the intestinal secretions, and removing it in the insoluble form in the fæces.

The possibility has not been overlooked that beryllium may be taken up from the food, and have a specific toxic effect on the growing bone. That this is probably not the case is indicated not only by the experiments just mentioned, in which beryllium *phosphate* added to the diet permitted of strictly normal growth, but also by the absence, histologically, of any evidence of toxic disturbance of the bone or cartilage cells. Moreover, qualitative chemical analysis of the ash of the bones and other tissues of the experimental animals has so far failed to reveal any recognisable quantities of beryllium, using a method sensitive to the presence of 1 part of beryllium in 100 parts of calcium.

(*b*) In the 'beryllium rickets' described above, and also in rickets produced in rats by the rachitogenic diet McCollum 3143 or Steenbock 2965, we have found that in addition to a very low plasma inorganic phosphate (in beryllium rickets values so low as 0·4 mgm. phosphorus per 100 c.c. plasma have been found), there is also a marked diminution in the *phosphoric ester content of the red blood cells*. Assuming the correctness of Robison's theory[3] of the function of the bone phosphatase in the deposition of bone salts, and that the phosphoric esters of the red cells form an important substrate for the activity of this enzyme, it would appear that rickets is explicable as the result, on the physico-chemical mechanism of bone deposition, of a two-fold handicap, first the low inorganic phosphate in the plasma, and secondly the low phosphoric ester content of the circulating blood. If vitamin D be added to the McCollum or the Steenbock diet of such rachitic animals, during the time the rickets is disappearing the phosphoric ester content of the red cells is increasing towards normal.

The above findings fit in very satisfactorily with the recent work of Shohl and collaborators[4] on rat rickets, of Theiler and Green[5] on the production of rickets and osteomalacia in herbivorous animals, and of Bodansky and his co-workers[6] on human rickets. The accumulated evidence may now be sufficient to support the corollary that the most important, if not the essential, effect of vitamin D in physiological quantities is to increase directly the intestinal absorption of phosphate (which normally implies increased uptake of calcium also) from the diet. It seems likely that, in the human, the functional efficiency of the intestine in the taking up of phosphate may vary markedly from one normal individual to another, the diet being the same. In certain stubborn cases of infantile rickets or adult rickets (osteomalacia) we may be dealing, essentially, with individuals in whom, as the result of an inborn or acquired functional defect of the intestine, this ability to take up phosphate from the contents of the gut is abnormally low, rather than with individuals in whom there is a deep-seated metabolic error or an essential deficiency in the process of bone formation itself. Their cure (if the intestinal absorptive mechanism had not degenerated too far) by the addition of generous quantities of vitamin D to the diet would then be explicable by the action of the vitamin not *directly* on the deposition of bone, but indirectly in stimulating phosphate uptake through the defective intestinal wall, a suggestion which, though not new, has hitherto been somewhat lacking in experimental support.

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[1] Branion, Guyatt and Kay, *J. Biol. Chem.*, 92, XI ; 1931.

[2] Bills, *et al.*, *J. Biol. Chem.*, 90, 619 ; 1931.

[3] Robison, *Biochem. J.*, 17, 286 ; 1923.

[4] Brown, Shohl, Chapman, Rose and Saurwein, *J. Biol. Chem.*, 98, 207 ; 1932 ; and several communications by Shohl *et al.*, for which references may be found in this paper.

[5] Theiler and Green, *Nutrition Abstracts and Reviews*, 1, 359 ; 1932.

[6] Bakwin, Bodansky and Turner, *Proc. Soc. Exp. Biol. and Med.*, 29, 1238 ; 1932.

Estimation and Distribution of Ascorbic Acid (Vitamin C) and Glutathione in Animal Tissues

MOST of the recorded measurements of the reduced glutathione content of tissues have been made by Tunnicliffe's method of titration with iodine on the assumption that the trichloracetic extracts of tissue contain little else but glutathione capable of reducing iodine in acid solution. A method depending upon a different principle was introduced by Mason, who found that the reduced glutathione content of liver, kidney and yeast extracts determined by titration against iodine is 120–200 per cent of the true value. His method has however been neglected, and the iodine method has been used almost exclusively. Recently, Bierich has evolved a third method for the estimation of reduced glutathione and has also obtained values much lower than those obtained by iodine titration. Ever since the discovery of ascorbic acid, it has been evident (as is mentioned by these workers) that where ascorbic acid occurs in the tissues, it will be estimated as glutathione in the iodine titration ; but it has been assumed without any evidence that ascorbic acid occurs only in traces except in the suprarenal cortex.

Using the indophenol titration method of Tillmans as modified in this laboratory for the estimation of ascorbic acid, we have found that ascorbic acid occurs in a number of organs in amounts comparable with that of glutathione, and that in organs other than the suprarenal cortex, up to 40 per cent of the iodine titre ('glutathione') may be accounted for by the ascorbic acid. Figures are given for blood, voluntary muscle, liver, kidney and the lens of the eye in the accompanying table. In view of this finding, data relating to the glutathione content of tissues, and factors influencing it, will require a thorough re-examination.

Tissue	Ascorbic acid (mgm. per gm.)	*N*/100 I_2 required for ascorbic acid present (c.c.)	Total N/100 I_2 required per gm. tissue (c.c.)	Per cent of I_2 titre due to ascorbic acid
Rat blood	<0·02	<0·023	0·197	<12
„ muscle	0·06	0·068	0·232	29
„ liver	0·15	0·188	1·14	16
„ kidney	0·22	0·25	0·910	27
Sheep liver	0·45	0·512	1·51	34
„ eye lens	0·46	0·52	1·64	32
Pig liver	0·38	0·432	1·44	30
Rabbit liver	0·40	0·455	1·33	34
„ kidney	0·25	0·285	0·655	43
Guinea pig liver, scorbutic	0·09	0·102	1·16	9
„ „ „ normal	0·30	0·34	0·97	35
Ox suprarenal cortex ..	1·62	1·85	2·40	77

From the data collected in the table, it will be seen that those tissues known to be rich in glutathione also have a high ascorbic acid content, and this coincident occurrence of the two substances has led us to formulate the working hypothesis that ascorbic acid and glutathione may be two linked factors in one system of oxidation in the animal cell. This has already led to the discovery of a thermolabile agent which is a catalyst for the dehydrogenation of ascorbic acid.

It must be borne in mind that although glutathione does not reduce 2–6 dichlorphenolindophenol under the conditions employed, there may be other unsuspected substances in the tissue extracts which will reduce the reagent, and therefore will be included in the estimation as ascorbic acid, causing too high a figure to be obtained. Fortunately, the ascorbic acid content as determined by the titration method can be checked by measuring the antiscorbutic activity of the tissue, and experiments with this object are already in progress.

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Action of Proteolytic Enzymes on the Oxytocic Principle of the Pituitary Gland

FOR more than a year we have been engaged in a study of the inactivation by enzymes of purified preparations[1] of the oxytocic principle of the pituitary gland. The stimulating action of the hormone on smooth muscle is slowly destroyed by aminopolypeptidase preparations from English brewers' yeast, and is rapidly destroyed by dipeptidase and proteinase preparations from the same source. Preparations of dipeptidase and aminopolypeptidase, with which Dr. Grassmann of Munich kindly presented us, also inactivated the hormone. None of the enzymes mentioned above is responsible for this inactivation. It is apparently due to an additional enzyme, present in these preparations, which has a *p*H optimum at 7·4.

Recently Freudenberg, Weiss and Eyer[2] stated that "die Wirkung der Substanz [the oxytocic hormone] von Pepsin und Erepsin nicht verändert, von Trypsin und Papain (auch wenn dieses nicht aktiviert ist) aber zerstört wird. Das Hormon ist entweder hochmolekular oder an einem hochmolekularen Träger der Eiweissgruppe gebunden. Offenbar gehört es dem Typus des Insulins an". We concur that papain preparations destroy the hormone rapidly, even more rapidly than do dipeptidase preparations, but the *p*H-optimum and *p*H-activity curve of the enzyme causing this destruction are the same as those of the yeast enzyme mentioned above. It is improbable, therefore, that the destruction of the oxytocic hormone is caused by a papainase, and we suggest that it is due to the presence in the papain preparations of an enzyme identical with, or similar to, the enzyme which we have detected in yeast.

Our experiments with the yeast enzyme and papain preparations will shortly be published *in extenso*. Experiments are in progress to identify the enzyme which destroys the oxytocic hormone, and we have been occupied for some time in investigating the constitution of the hormone by studying its behaviour with other enzymes and with chemical reagents. The results of an investigation of the action of nitrous acid and other reagents on the hormone have already been published[3].

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[1] Gulland and Newton, *Biochem. J.*, 26, 337; 1932.
[2] Freudenberg, Weiss and Eyer, *Naturwiss.*, 20, 658; 1932.
[3] Gulland, *Chemistry and Industry*, 52, 160; 1933.

Predissociation and Pressure Effects in the Band Spectrum of Aluminium Hydride

BY the aid of graphical methods[1], we have constructed the potential curves $V_J(r)$ for different rotational states of $^1\Pi$ in aluminium hydride. From estimations on the line width of the diffuse lines in the $^1\Pi \rightarrow {}^1\Sigma$ band system, we were able to extend our constructions to wide nuclear spacing ($r \sim 3 \times 10^{-8}$ cm.) as shown in Fig. 1. Reproducing the curve $V_0(r)$ for $J = 0$ $\left[V_J(r) = V_0(r) + \frac{h}{8\pi^2\mu r^2} J(J+1)\right]$ we found, that even now a potential barrier remains in $^1\Pi$, the height of which is ~ 400 cm.$^{-1}$, as related to the limit of dissociation. This result appears somewhat surprising, as in the few cases hitherto investigated (hydrogen, mercury hydride, etc.) a smooth approach of the potential curves to the limit of dissociation has been assumed. We are not in the position to distinguish between the alternatives, whether this barrier is a feature of the $^1\Pi$-state itself or produced by the intersection of some unknown and repulsive $^1\Pi^*$-state, as suggested in Fig. 1. In the latter case, the actual $^1\Pi$-curve should be correlated to some excited state in the Al atom as already suggested by Kronig[3], although for other reasons. In any event, by this construction the level scheme of AlH has been related to that of the Al atom, the position of the level $v = 0$, $J = 0$ in $^1\Pi$ situated 1400 ± 50 cm.$^{-1}$ below the limit of dissociation. Incidentally, it may be mentioned that some interesting cases of perturbations and predissociations in the excited $^1\Sigma'$ and $^1\Sigma''$ states[4] are readily explained hereby.

The transparency of the potential barrier to the de Broglie waves is a well-known effect[3], which has been applied especially to the problems of the disintegration of atomic nuclei and molecules. Generally, the effect of transparency is given by an expression $\frac{\omega}{\pi} e^{-\beta_J}$, where $\beta_J = \frac{4\pi}{h} \int_{r_1}^{r_2} \sqrt{2\mu\,[V_J\,(r) - E]}\,dr$. In the special case here considered, the life of molecules in $^1\Pi$ is thereby reduced from 10^{-8} sec. to $\sim 10^{-13}$ sec. in the most excited rotational states observed. In addition, we wish to point out a reciprocal effect, which comes into play when we consider the problem of molecular formation. In cases of resonance between the system of free atoms and the molecule formed, the probability of capture per collision is determined by an expression $\sim e^{+\beta_J}$. Apparently, this resonance effect plays an important rôle, influencing the processes of exchange between atomic and molecular states [$\mathrm{Al} + \mathrm{H} \rightarrow \mathrm{AlH}$] in favour of molecular formation. To speak more figuratively, the barrier acts as if perforated by a system (J, v) of narrow channels, by which the molecular formation and dissociation takes place.

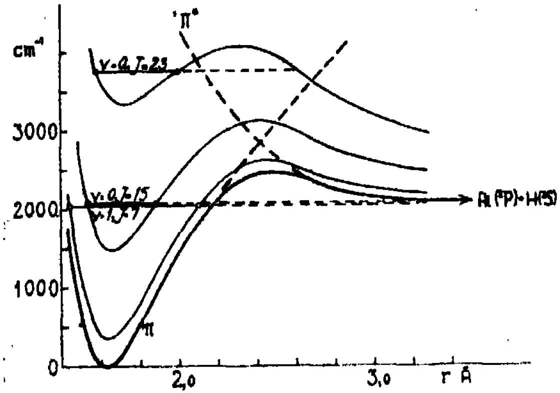

FIG. 1.

Applying these considerations to the case of AlH, we expect an excess in the number of molecules of those rotational levels which are situated close above the limit of dissociation in $^1\Pi$, an effect clear enough to be distinguished from those determined by the thermal and electronic activation of the molecules. From a close examination of the intensity distribution in the bands of $^1\Pi \rightarrow {}^1\Sigma$, emitted by an aluminium arc burning in pure hydrogen of one atmosphere pressure, we found that the lines originating from the rotational levels $J = 15$ in $v = 0$ and $J = 7$ in $v = 1$ exhibit distinct peaks on the smooth curves of intensity, given by the expression $ie^{-\frac{E}{kT}}$. It must be emphasised that these lines still belong to the type of sharp band lines, the disintegration of the molecule in the initial state being protected by an almost impenetrable potential barrier.

At low pressure (~ 10 mm. mercury) in the arc, the exciting conditions are mainly due to electronic activation of the molecules. In the states of predissociation, by increasing pressure, this effect is superposed by the effect of molecular formation. The sensible influence observed[4] of the hydrogen pressure on the intensity of the diffuse lines may be *interpreted by the aid of the mechanism of resonance*, suggested above. Although somewhat hampered by the damping factor $e^{2\beta}$, the resonance process must be largely favoured by an increasing number of molecules within the radius of interaction of the individual Al + H process.

Details regarding the investigation will be given later.

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[1] R. Rydberg, *Z. Phys.*, 73, 376; 1931. *ibid.*, 80, 517; 1933.

[2] R. de L. Kronig, *Z. Phys.*, 62, 300; 1930. Regarding the constructions of the potential curves of AlH we made use of a more exact relation between the line width and the potential barrier, recently developed by G. Müller, *Z. Phys.*, 79, 595; 1932.

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[4] E. Bengtsson and R. Rydberg, *Z. Phys.*, 59, 540; 1930.

New Experimental Evidence in the Sulphur-Hydrogen Reaction

BODENSTEIN[1] studied this reaction in sealed bulbs containing excess of sulphur, and found a temperature coefficient of 1·34 between 234° and 283°, and 1·77 between 310° and 356°. His work was criticised, by Norrish and Rideal[2], as possibly vitiated by the hydrogen sulphide liberated on the solidification of the residual sulphur, and as leaving uncertain, in view of the variable temperature coefficient, the part played by the walls of the bulbs. These workers employed a dynamic method, and showed that the logarithms of the total reaction velocity—always, however, measured in the presence of nitrogen—when plotted against absolute temperature yielded a curved line. The differences in the velocities obtained, using hydrogen at partial pressures of 0·810 atm. and 0·304 atm., respectively, when suitably plotted gave a straight line which was interpreted as belonging to the gaseous reaction alone, since the surface reaction, common to each series, was assumed, and reasonably so, to be independent of pressure. The velocity of the composite reaction was also shown experimentally to be increased by increasing the glass surface, to which it was stated to be proportional; and to be independent of the amount of sulphur present. Knowing the contribution of the gaseous reaction, data for the surface were deduced, and thus the temperature coefficient of each reaction was obtained: homogeneous 2·19, heterogeneous 1·48.

The assumption, fundamental to their deductions, made by Norrish and Rideal, that nitrogen is without effect on the velocity of the formation of hydrogen sulphide, has not been borne out by our re-examination of the problem. Actually, nitrogen definitely increases the velocity of the gaseous reaction over practically the whole of the temperature range under consideration. Furthermore, we have been unable to obtain any evidence of the heterogeneous reaction, described by them as taking place on the glass surface of the vessels. A heterogeneous reaction of some magnitude has, however, been observed, but it is confined to the surface of the sulphur, its velocity being proportional to the area thereof.

At 760 mm., in pure hydrogen, when precautions were taken to keep a uniform pool of sulphur in the reaction vessel, the dynamic method, in our hands, gave a practically straight log d [H_2S]/dt against $1/T$ plot between 265° and 350° The velocities were unaffected by an increase in the surface/volume ratio of 500 per cent, but were appreciably altered by changes in the area of liquid sulphur; in the latter case, within certain limits, the temperature coefficient of the total reaction was not sensibly changed, provided the particular areas were kept constant throughout the temperature range. The introduction of nitrogen resulted in a curve, similar in form, and close in actual position, to that of Norrish and Rideal, and the velocities were somewhat higher than was warranted by the partial pressure of hydrogen employed.

A study of the gas reaction was made, statically, in bulbs, wherein the amount of sulphur was always more than twenty times that converted to the hydride, but was, nevertheless, insufficient to allow of any liquid being present. The surface/volume ratio and the pressure of hydrogen were varied, and the results showed that the velocity of hydrogen sulphide formation was: (1) proportional to the concentration of hydrogen; (2) proportional to the square root of the concentration of sulphur; (3) independent of the area of the glass surface.

The plot of log $d[H_2S]dt$ against $1/T$ was perfectly straight, and gave a temperature coefficient of 1·94. With the same partial pressure of hydrogen, in the presence of nitrogen, log d [H_2S]dt against $1/T$ was decidedly curved, and the velocities were appreciably greater than with pure hydrogen. The difference, brought about by the nitrogen, points to a chain mechanism, and the investigation is proceeding with the substitution of helium for nitrogen, and with the limitation of the space for chain formation. The gaseous reaction proceeds in accordance with the equation,

$$d\,[H_2S]/dt = K\,[H_2] \times \sqrt{[S]}.$$

Two or three forms of chain mechanism suggest themselves, but we hesitate to differentiate between these in the absence of other data which are at present being sought.

By a modification of the shapes of the bulbs, whereby three pools of liquid sulphur, of different sizes, were exposed to the action of hydrogen, the composite reaction, in the presence of known areas of sulphur, was investigated. The velocity of the surface reaction was computed by deducting that of the homogeneous one from the composite figure, and its temperature coefficient was estimated from the results obtained. The reaction at the surface of liquid sulphur proved to be: (1) proportional to the area of the liquid exposed; (2) proportional to the pressure of hydrogen. It gave a straight log d [H_2S]/dt against $1/T$ plot, from which a temperature coefficient of 1·85 was calculated. The surface reaction proceeds in accordance with the equation,

$$d\,[H_2S]/dt = K \times \text{area of liquid sulphur} \times [H_2].$$

Although Bodenstein failed to recognise the composite nature of the reaction between hydrogen and sulphur, first suggested by Norrish and Rideal, he evidently believed it to have the characteristics of the gaseous reaction here described, in spite of the fact that his analytical results did not entirely confirm this view. His approximate methods also obscured the effect of the heterogeneous reaction occurring at the sulphur surface and prevented its detection.

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[1] *Z. phys. Chem.*, **29**, 315; 1899.
[2] *J. Chem. Soc.*, **123**, 696; 1923.

Variation Problems for a Symmetrical Region

IN a review in NATURE[1] it is stated that the equation of conduction of heat can be regarded only as a *limiting* case of an equation arising in the calculus of variations. A successful attempt has been made, however, to derive the equation directly from a variation problem of an unusual type.

It is found that if we write

$$u = F\,(x, t),\ v = F\,(x, -t)$$

and integrate

$$\frac{\delta u}{\delta x}\,\frac{\delta v}{\delta x} \times v\,\frac{\delta u}{\delta t}$$

over a region bounded by the lines $x = \pm a, t = \pm b$, requiring F to be zero on the boundary, the variation of the resulting integral I gives rise to the differential equation

$$\frac{\delta^2 u}{\delta x^2} = \frac{\delta u}{\delta t}.$$

A physical meaning for I has not yet been found.

A variation problem for a symmetrical domain usually gives rise to a functional equation such as $F''\,(t) = n^2\,F\,(-t)$. A solution $F\,(t) = A \cosh\,(nt) - B \sin\,(nt)$ of this equation may be found by splitting $F\,(t)$ into its even and odd parts, a device that is often useful.

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[1] NATURE, **129**, 850, June 11, 1932.

IF, in Prof. Bateman's example, we take

$$F\,(x,\ t) + F\,(x, -t) = 2\,\varphi\,(x, t),$$
$$F\,(x,\ t) - F\,(x, -t) = 2\,\psi\,(x, t),$$

then φ and ψ may be regarded as independent of each other, and the variational equations are

$$\frac{\delta\varphi}{\delta x^2} = \frac{\delta\psi}{\delta t}, \qquad \frac{\delta^2\psi}{\delta x^2} = \frac{\delta\varphi}{\delta t}.$$

It is true that the equation $\frac{\delta^2 u}{\delta x^2} = \frac{\delta u}{\delta t}$ can be derived by adding these two equations, but it represents only a *part* of the variational system: *the whole* set consists of the above two equations, which when we eliminate ψ give

$$\frac{\delta^4\varphi}{\delta x^4} = \frac{\delta^2\varphi}{\delta t^2},$$

and I regard this as the true differential equation arising in Prof. Bateman's problem.

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Fluorescence of Pure Salts of the Rare Earths

Investigating the connexion between the emission spectra in colourless materials[1] and the absorption spectra of the ions of the rare earths[2] we have found that the pure salts of the rare earths can also exhibit a fluorescence of a surprising brightness. Up to the present, this fact was still very doubtful[3]. Under excitation with violet and ultra-violet light, europium sulphate in particular shows a brilliant red fluorescence. Terbium sulphate fluoresces also very strongly with a pale greenish colour. The luminosity of the sulphates of samarium and dysprosium is weaker. Our samples of the sulphates of holmium and erbium showed no perceptible emission. The spectra emitted are very sharp, especially at lower temperatures.

Conclusive proof that the emission is to be ascribed to the pure salts and not to any impurities is given by comparing these spectra with the phosphorescence spectra, when the same ion (in a small amount of about 0·1 per cent) is embedded in a colourless salt by heating. The agreement between the particular groups in the spectra of a given ion shows at the first glance[4] that the fluorescence is due to the ion of the pure salt. Therefore this emission is of the same type as that of the uranyl salts and also the duration of the fluorescence is of the same order.

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Feb. 10.

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[1] Nature, 130, 740; 1932.
[2] *Z. Phys.*; 1933.
[3] Geiger-Scheel, "Handb. d. Phys.", 2nd ed., vol. 23, 1, p. 276; 1933.
[4] Details and illustrations are being published in the *Physikalische Zeitschrift*.

New Evidence for the Positive Electron

The experiments of Anderson[1] and of Blackett and Occhialini[2] on the effects produced in an expansion chamber by the penetrating radiation strongly suggest the existence of positive electrons—particles of about the same mass as an electron but carrying a positive charge.

Some observations of the effects produced by the passage of neutrons through matter, and the experiments of Curie and Joliot[3] in which they observed retrograde electron tracks in an expansion chamber, led us to consider the possibility that positive electrons might be produced in the interaction of neutrons and matter, and we have recently obtained evidence which can be interpreted in this way.

A capsule containing a polonium source and a piece of beryllium was placed close to the wall of an expansion chamber. On the inside of the wall was fixed a target of lead about 2·5 cm. square and 2 mm. thick. This lead target was thus exposed to the action of the radiation, consisting of γ-rays and neutrons, emitted from the beryllium. Expansion photographs were taken by means of a stereoscopic pair of cameras. A magnetic field was applied during the expansion, its magnitude being usually about 800 gauss.

Most of the tracks recorded in the photographs were, from the sense of their curvature, clearly due to negative electrons, but many examples were found of tracks which had one end in or near the lead target and showed a curvature in the opposite sense. Either these were due to particles carrying a positive charge or they were due to negative electrons ejected in remote parts of the chamber and bent by the magnetic field so as to end on the lead target. Statistical examination of the results supports the view that the tracks began in the target and therefore carried a positive charge.

Strong evidence for this hypothesis was acquired by placing a metal plate across the expansion chamber so as to intercept the paths of the particles. Only a few good photographs have so far been obtained in which a positively curved track passes through the plate and remains in focus throughout its path, but these leave no doubt that the particles had their origin in or near the lead target and were therefore positively charged. In one case the track had a curvature on the target side of the plate, a sheet of copper 0·25 mm. thick, corresponding to a value of $H\rho$ of 12,700; on the other side the curvature gave a value $H\rho = 10{,}000$. This indicates that the particle travelled from the target through the copper plate, losing a certain amount of energy in the plate. The change in the value of $H\rho$ in passing through the copper is roughly the same as for a negative electron under similar conditions. The ionising power of the particle is also about the same as that for the negative electron. These observations are consistent with the assumption that the mass and magnitude of the charge of the positive particle are the same as for the negative electron.

The manner in which these positive electrons are produced is not yet clear, nor whether they arise from the action of the neutron emitted by the beryllium or from the action of the accompanying γ-radiation. It is hoped that further experiments now in progress will decide these questions.

Our thanks are due to Mr. Gilbert for his help in the experiments.

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[1] Anderson, *Science*, 76, 238; 1932.
[2] Blackett and Occhialini, *Proc. Roy. Soc.*, A, 139, 699; 1933.
[3] Curie and Joliot. "L'Existence du Neutron". Hermann et Cie, Paris.

Summer Thunderstorms

The annual record of thunderstorms occurring in the six summer months is being continued during 1933.

A note of the place, date and time of the occurrence of thunder, lightning or hail, in any part of the British Isles, between April 1 and September 30, with the direction in which the lightning was seen, especially at night, will be extremely useful. In the case of actual thunderstorms, information as to the time of first observation of thunder or lightning, time of commencement of very heavy rain or hail, or approximate time of nearest approach of storm, and approximate time of final observation of thunder or lightning will be valuable.

It is essential that the position from which the observation is made should be specified, and that the standard of time used should be stated. More data are particularly required from rural and moorland districts and from thinly populated areas generally.

S. Morris Bower.

Langley Terrace,
Oakes,
Huddersfield.
March 22.

Research Items

Iron-working in the Bahr el Ghazal. Mr. T. C. Crawhall in *Man* for March describes the processes of iron-working and forging as practised by the Jur of the Sudanese province of Bahr el Ghazal, which are illustrated by some exhibits recently acquired by the Science Museum through Capt. J. F. Cumming, district commissioner. The ore is smelted in a clay furnace, 5 ft. high, with four clay tubes inserted in the side of the furnace near the bottom for ventilation, and a hole at the bottom of the furnace, which is sealed with clay during the period of smelting, for the extraction of the iron. There is no forced draught. The iron ore is broken into small pieces, about one inch cube, and separated into two kinds, known as the male and female elements. Both, it is believed, must be present before iron can be produced. Sixteen baskets of hardwood charcoal are used to three baskets of ore. One such charge, taking about twenty-two hours for smelting, produces only enough iron to make eight or ten spearheads. The iron collects at the bottom of the furnace and is removed by long poles pointed at the ends, pulled along the ground by native-made rope, and then quenched with water. It is then broken into small pieces for treatment at the forge. The forge is situated in a grass hut, mainly to prevent the sun from shining on the iron. Should this happen, it would be impossible to work it. Great deference is paid to the smith, and oaths sworn on his anvil, a rough piece of iron driven into a palm-tree buried in the ground, are inviolable. The charcoal is raised to the temperature necessary to soften the iron by two rows of bellows, of which the chief interest is that they exactly resemble the bellows used in ancient Egypt and shown on a drawing from a tomb at Thebes of about 1500 B.C. They are made of clay covered with goatskin, and have no valves. The nozzles, therefore, do not enter the fire, but each pair rests in a clay junction unit which has one end in the fire and the other open to the air to admit the inward draught.

Hawaiian Tradition. An interesting document has recently come into the possession of the Bernice P. Bishop Museum, Honolulu, and is edited under the title "Kepelino's Traditions of Hawaii" by Martha Warren Beckwith (Bulletin 95). The manuscript was for some years in the possession of the Roman Catholic Mission of Honolulu, for which it was composed by Kepelino, a descendant of the priestly race of Paao, born in Hawaii about 1830, and transcribed by Bishop Maigret. Although Christian influence is present, the record bears the mark of authenticity and sincerity. Of the gods it is said that three classes of gods were recognised in the history of Hawaii: the great gods, the class of spirits who were created and of men, that is the guardian spirits, and thirdly the class of things without souls. The great gods were male gods; they had no source; they made all things and all power was theirs. These gods made many gods to serve them and they made man and all things. In the second class there were many gods and these were subdivided into three kinds: the spirits without a body, the *aumakua* of day, and secondly the *aumakua* of night, the dead, and in the third class, district chiefs. The last are put in the class of gods because, as ruling chiefs, they had great power and also because of the *tapu* observed towards them, a thing to be dreaded. Also they had the power of life and death. They were called "gods that could be seen". They were sometimes worshipped. The *tapu* of the gods covers all men and all chiefs, while the *tapu* of the chiefs covers only the commoners with the exception of the *kahuna* and his people. The chief's *tapu* had many laws of death, such as that if one did not prostrate oneself when the chief came forth or sit when the chief's bathing water went by, or if one walked about when the chief's name was chanted, the penalty was death.

Indian Microlepidoptera. Scientific Monograph No. 2 of the Imperial Council of Agricultural Research (India) entitled "Life-Histories of Indian Microlepidoptera" has recently come to hand. In this memoir, Mr. T. Bainbrigge Fletcher, Imperial entomologist, has continued his studies of these small moths. The present contribution deals with the life-histories of a number of species belonging to the groups Alucitidæ, Tortricina and Gelechiadæ the transformations of which, in many cases, are figured on the accompanying plates. Notwithstanding their small size, certain of these insects have a very extensive geographical range and included among them are destructive species of great economic importance. Students of the groups concerned will find many hitherto unknown life-histories described. The monograph is issued by the Government Publication Branch, Calcutta (Rs. 3–4 or 5*s*. 6*d*.).

Culture of Snail's Tissue. J. Brontë Gatenby and E. S. Duthie have recorded (*J. Roy. Micr. Soc.*, 52, pt. 4; 1932) observations on the histology of the wall of the pulmonary cavity in *Helix aspersa*. They describe the normal regeneration of the wall after cutting in the living snail, and give a preliminary account of the behaviour of small pieces of the wall when cultivated in hanging drops of the snail's blood. In the process of normal regeneration no mitotic divisions were seen, while figures suggestive of amitosis were extremely common. In no case have the authors seen mitoses in the cultures where cell multiplication is rapidly taking place, but even a few minutes after the tissue has been placed in blood, and put under the microscope, constriction and separation of cells by the amitotic method has been observed. It is concluded therefore that in culture and in normal regeneration, and probably also in normal growth, the cells of the snail multiply by amitosis. The paper is illustrated by thirteen figures. (See also NATURE, 130, 668, Oct. 22, 1932.)

Fluorescence in Ryegrasses. Rapid developments are taking place in the application of Gentner's screened ultra-violet light test for *multiflorum* characters in *Lolium*. The use of the test has passed into routine practice in a number of seed-testing and herbage research stations and new directions in which it is of service are multiplying. In view of the somewhat expensive nature of mercury vapour and other ultra-violet ray lamps, it is satisfactory to find that filtered daylight may be successfully employed. Linehan and Mercer record (*Proc. Internat. Seed Testing Assoc.*, 4, No. 2; 1932) efficient performance of a Dutch instrument for daylight use. A similar instrument of British manufacture is now available. In a recent communication to the Editor, Messrs.

E. W. Hullett and J. W. Calder, of Canterbury Agricultural College, New Zealand, point out that evidently only the longer wave part of the ultra-violet light spectrum is necessary, since ordinary laboratory glass does not markedly reduce the intensity of the fluorescence. These authors report success with several types of ultra-violet ray generator and with daylight passed through a Wood's filter. The fundamental physiological causes of the fluorescence phenomenon remain obscure, and merit biochemical and physical research in view of their probable importance to plant physiology generally. It is interesting to note, however (Linehan and Mercer, NATURE, 131, 202, Feb. 11, 1933), that despite apparent complexity of these causes, fluorescence behaves, in hybridisation, as a simple Mendelian dominant.

Migration of Oil and Natural Gas. Most geologies of petroleum devote considerable space to problems of oil migration within the earth's crust in an attempt to explain how it is that petroleum makes its way into the reservoirs from which it is at the present time produced. Ever since the inception of theories of origin and accumulation of oil, attempts have been made to explain the forces which have caused the movement of the oil through the earth's crust and it must be admitted that there has been a good deal of uninspiring repetition of old theories without regard for the results of experimental work or for the records of field technology now available from well-understood oilfields throughout the world. The study of migration has been made a special one by Prof. V. C. Illing for some years past. His paper before the Institution of Petroleum Technologists on March 7 showed clearly that he is not satisfied with mere repetition of theories. Apart from giving results of experimental work carried on for some years past at the Royal School of Mines, he emphasised that migration is bound to be a twofold process: a primary movement of oil and gas from source rocks to reservoir rocks and a secondary movement of segregation within these rocks and thus the ultimate distribution of oil and gas as pools. Primary migration is ascribed to compaction aided by internal or external sources of pressure, in which phase the oil originates. Secondary migration implies separation of gas, oil and water within the coarse rocks, sometimes due to static buoyancy but probably in the main due to flotation in mobile fluids. Such previously accepted theories as buoyancy, capillarity or hydraulic currents as being responsible, are, the author contends, inadequate, and even Munn's theory fails to explain the retention of oil in coarser rocks.

Photoconductive Effect in Carborundum Crystals. In a communication to the Editor, Prof. Kamienski, of the Institute of Physical Chemistry and Electro-Chemistry, Jagellonian University, Cracow, has observed that some carborundum crystals exhibit a photoconductive effect. A Lindemann electrometer connected across a xylol-alcohol resistance in series with the crystal and a small battery were used to investigate the phenomenon. In a typical case the crystal had an area of 2·5 sq. mm., the xylol-alcohol resistance was of rather less than one tenth the resistance of the crystal in the dark, and a 4-volt battery was used. A small lamp carrying 0·25 amp. at 2·5 volts was used: when it was 1 cm. from the crystal the electrometer indicated 2·2 volts, at 5 cm. it indicated 0·7 volt, and at 10 cm. it indicated 0·4 volt. In contrast with selenium cells, these crystals give very steady and reproducible results. Prof. Kamienski states that the inertia is low; when the crystal is illuminated, the electrometer needle shows immediately a deflection nearly as great as the ultimate equilibrium value, which is attained in 2–4 minutes. Some crystals show a different photo-sensitivity according to the direction the current is flowing; others have an almost equal sensitivity for both directions. Messrs. Adam Hilger Ltd. have carried out experiments on one of these crystals and have confirmed these results. They also found that the range of sensitivity of the crystal was about 3000–5500 A., and that it was most sensitive to light of wave-length about 4000 A.

Photographic Sensitisers for the Infra-Red. In the *Journal of the Chemical Society* for February, Miss N. I. Fisher and Miss F. M. Hamer publish an account of the syntheses of several tricarbocyanines. These dyes are photographic sensitisers for the infra-red between 7000 A. and 10000 A.

New Lens of High Rapidity for Cinematography. Messrs. Carl Zeiss of Jena have placed upon the market a new cinematograph camera lens with an aperture of *F* 0·85. The lens is known as the 'R-Biotar'. It has already proved very successful in providing an X-ray cinematograph record of the pulsating organs of the body. Actually, of course, the fluorescence image produced on a screen was photographed; the great rapidity of the new lens makes this work much more satisfactory than was previously possible. We are informed that the price of the lens in Great Britain is about £48.

Electrostatic Production of High Voltages. Van de Graaf, Compton and Van Atta, working at the Massachusetts Institute of Technology, have developed a very direct method for the production of high direct current potentials (*Phys. Rev.*, Feb. 1). Electric charges are sprayed by point discharge on to the surface of a moving insulating belt which carries them into the interior of a large insulating sphere. The charges are removed from the belt by a point-collector system inside the sphere and the latter becomes charged to a high potential. The charge conveyed by the belt is limited by the electrostatic intensity in the air at the surface of the belt, and the maximum potential is limited by leakage and discharge from the sphere. In a model generator with a pair of 24-inch spheres 25 microamperes was obtained at about 1,500 kilovolts, and this generator was simple and cheap to construct. A very large generator is now being constructed with 15-foot spheres supported on 24-foot towers of shellac insulating compound, inside which the belts are to run. Each of the two spheres will form a laboratory room and a discharge tube will be supported between the two spheres. Simultaneously with the development of the high voltage generator, a discharge tube has been evolved consisting of an insulating fibre (shellac compound) tube with flat metal ends. The electric field around the cylinder is made uniform by providing a spiral indian-ink leak round the outside of the tube. About 300 kv. was applied to a tube of this type without puncture, the voltage being limited by discharge and the current capacity of the electrostatic generator.

Viscosity of Aqueous Solutions. Grinnell Jones and S. K. Talley (*J. Amer. Chem. Soc.*, Feb.) describe some very accurate experiments on the viscosities of aqueous solutions of six salts and also sucrose and urea at 25°. The Ostwald type viscometer was of quartz, internally ground and polished, and the transit of the meniscus was timed automatically by means of a photoelectric cell. The viscosities confirm the prediction made by Jones and Dole on the basis of the Debye theory of interionic attraction that all salts will increase the viscosity of water if measured at sufficiently low concentration. This is the case even for those salts which produce a diminution in viscosity at higher concentrations, including potassium chloride, chlorate and nitrate, ammonium chloride and cæsium nitrate. The viscosity-concentration curves for these salts go through a minimum. Jones and Dole had shown that the fluidity of a salt solution should be related to the concentration by an equation of the form $\varphi = 1 + A\sqrt{c} + Bc$, where A and B are constants. A should be negative for all electrolytes but zero for non-electrolytes, whilst B may be either positive or negative. This equation, based on the Debye-Hückel theory, is found to hold, and the results also confirm the equation of Falkenhagen and Vernon, in which the value of the constant A is calculated in terms of the mobilities of the two ions. In the case of the two non-electrolytes, the square root term was absent, as it should be when no ions are present in the solution.

Oxidation and the Lubricating Properties of Oil. In a paper in the *Proceedings of the Royal Society* for February, R. O. King describes experiments on lubrication by oil in a state of strong oxidation. A blended mineral oil was circulated through a journal bearing, the temperature of the bearing was artificially raised by a gas-burner, and the the oxidation of the oil was promoted by blowing air through the hot oil. It was found that as the trial of a sample of oil proceeded, the viscosity increased slightly, but the bearing friction at high temperatures decreased and the temperature of seizing was pushed up to very high values. In one case, for example, the coefficient of friction had the very low value of 0·00045 with the bearing running at about 250°. The lubrication of a bearing of this kind under ordinary conditions is of the 'fluid friction' type, but the friction observed under the oxidation conditions is too low to be explained in this way, and the author suggests that the 'oxidation lubrication' is of a quite different type in which activated molecules formed in the initial stages of oxidation become attached to the surfaces and build up a boundary layer. The conditions are then something like those of 'boundary lubrication' described by Hardy but the special nature of the activated molecular film permits a surface of very free slip to be formed.

Astronomical Topics

Astronomical Notes for April. Mercury is in elongation as a morning star on April 20, but is not well placed for northern observers. Jupiter and Mars continue to be well placed, in Leo. Mars is stationary on April 13, not far from Regulus; after this it will approach Jupiter until the evening of June 4, when they are only 15′ apart. Neptune is also in Leo. Venus and Uranus are too near the sun for observation; the former becomes an evening star on April 21, but will not be easily observable until June.

An occultation of Regulus is visible in the southern portion of England on the evening of April 6; the northern limit runs roughly from Liverpool to Dover. Many observers are making expeditions to the limiting line, in the hope of locating this with precision. At Greenwich, disappearance occurs at 8.57 p.m., and reappearance at 9.10 p.m., 24° east of the north point. The smallest instrument will suffice for the observation. Other disappearances of faint stars occur in London on April 1 at 10.10 p.m., on April 29 at 10.42 p.m. and on April 30 at 11.30 p.m. Minima of Algol occur on April 1 at 11.40 p.m. and on April 4 at 8.30 p.m.

Comet Pons-Winnecke should be visible with moderate instruments at the end of April and in May. Search ephemerides are given in B.A.A. Handbook for 1933.

Summer time begins on the morning of April 9, a week earlier than usual, owing to the third Sunday being Easter. Summer time is not used in these notes, and should not be used for astronomical records. After April 9, the times given here need to be increased by one hour to give the summer time.

The Minor Planet Amor. This is the interesting planet discovered by M. Delporte at Uccle a year ago, when it approached the earth within ten million miles. It was observed for nearly three months; *Astronomische Nachrichten* No. 5936 contains a careful discussion of its orbit by Dr. A. Kahrstedt of the Berlin Rechen-Institut.

Epoch 1932 April 6.0 Greenwich Time; mean anomaly 0·45458°; arc from node to perihelion 25·24671°, node 171·13239°, inclination 11·93816°, eccentricity 0·4358886, mean daily motion 1329·6154″, semi-major-axis 1·9239201, period 974·718 days. It is pointed out that the period is to that of the earth as 8 to 3, so that 8 years bring about a recurrence of favourable conditions. Search ephemerides are given for the spring months of 1916 and 1924, in the hope that a re-examination of plates exposed then may disclose some images of the planet; these would be of great use in improving the orbit determination, and facilitating the recovery of the planet. Its motion when near the earth is so rapid that the long trails on plates might have been taken for those of meteors.

Since the least distance of this planet is only two thirds of that of Eros, it may be used for determining the solar parallax and the mass of the moon, as soon as its orbit is accurately known.

Measures of Double Stars at the Union Observatory, Johannesburg. Bulletin 241 of the Astronomical Institute of the Netherlands contains further instalments of the systematic survey of the southern heavens for double stars, which is being carried out by W. H. van den Bos with the 26-inch refractor at the Union Observatory. Accurate measures are given for 158 stars; a considerably longer list contains estimates of positions and magnitudes; in about half the stars of the first list the separation is less than 1″, and several are so small as 0·1″. In four cases, closer companions of previously known pairs have been detected. The primaries are nearly all in the Bonn or Cape Durchmusterung, their reference numbers in these being given.

Early Man in East Africa

TO discuss the early human remains recently discovered by the East African Expedition of Dr. L. S. B. Leakey, the Royal Anthropological Institute convened a Conference on March 18 and 19 to examine the material which is now assembled in Cambridge. After hearing Dr. Leakey's exposition of his discoveries, and a general discussion of questions arising therefrom, the conference appointed committees to report respectively on the geological, palæontological, anatomical, and archæological evidence. The reports of these committees were submitted to the conference as follows :—

GEOLOGY

The Geological Committee has considered the problems placed before it from the point of view of the material available for examination and of the stratigraphical evidence. (*a*) Material : i. *Kanjera*. The Committee agreed that the fragments of skull picked up from the surface have the same source as those found *in situ*, their state of mineralisation being similar. ii. *Kanam*. So far as can be determined from the tests made, the mineralisation of the Kanam mandible seems to be the same as that of the rhinoceros bone found in the same deposit. (*b*) Stratigraphical. Of the geologists present on the Committee, two have seen the Kanjera deposits, although not with Dr. Leakey. Others have had experience of similar strata in East Africa, and the rest have brought to bear on the question their general experience of stratigraphical problems. From the evidence supplied by Dr. Leakey, the Committee can see no escape from the conclusion that the Kanjera skull fragments occur in the calcareous deposit which yielded the following fauna : *E. antiquus recki*, etc., as in the palæontological report below, and the implements of evolved Chellean type. Further, that the Kanam mandible was derived from the horizon which yielded implements of pebble-tool type only. This horizon also furnished the following fauna : two species of mastodon, two of primitive elephant, a species of deinotherium and a small variety of hippopotamus.

The Committee, after considering the character of the Kanjera deposit, does not believe that the fragments can have been introduced into the calcareous deposit at a later date, and feels clear that the two fragments said to be found *in situ* belong in fact to the original deposit. Also, those members of the Committee who have seen the deposits in question, support Dr. Leakey in his view that the Kanam and Kanjera deposits antedate a period of great local tilting and faulting and of volcanic activity.

PALÆONTOLOGY

The Committee on Palæontology reports that Kanam East and Kanam West exhibit differences only in the relative numbers of the fossils of different groups. With the human jaw at Kanam West were found close relatives of the two types of rhinoceros still living in the region, a small hippopotamus, a pig, an antelope, fragments of mastodon, two teeth of a very large deinotherium and remains of *Trionyx*. In Kanam East the collection consists chiefly of mastodon with a primitive elephant, deinotherium, and a few specimens of hippopotamus, rhinoceros, horse, and a young monkey.

The fossils from Kanjera have a later aspect. One elephant has dental plates as deep as those of *E. antiquus*, and all the remains of elephant are of Asiatic or European type. At least two antelopes, *Hylœochœrus*, *Phacochœrus*, and a large pig distinct from that of Kanam West, have a very modern appearance. A baboon is remarkable for its comparatively short face. One equine upper molar approaches *Hipparion*, if it does not actually belong to that genus. Typical *Equus* also occurs. Fragments of mastodon, rhinoceros, a giraffoid, hippopotamus, and a carnivore have also been found.

The Committee thinks that the Kanam deposit should be referred to the Lower Pleistocene, in which the deinotherium and mastodon are survivals from the Upper Pliocene. It also thinks that the Kanjera fauna cannot be later than the Middle Pleistocene.

ANATOMY

The Anatomical Committee reports as follows :—

A. Kanjera No. 3.—(1) These specimens exhibit a condition consistent with great antiquity, and the Committee agrees to the correctness of associating all the fragments in question. (2) In the specimens submitted to them the Committee has observed no characteristics inconsistent with the reference to the type of *Homo sapiens*. (3) The absence of a frontal torus seems to exclude Kanjera No. 3 from association with Neanderthal types. (4) Pending further inquiry, the Committee is not able to cite examples of cranial vaults of the thickness characterising Kanjera No. 3 in non-pathological examples of the modern types of *Homo sapiens :* but it notes the occurrence in Piltdown (*Eoanthropus*) and the Boskop calvaria. (5) The Committee has noted the presence of a transverse occipital suture, which is rare in modern crania. (6) While reconstructions must be to some extent conjectural, yet those submitted agree in indicating a cranial length of 200–209 mm. (7) The Committee has observed no detail in the fragment of femur inconsistent with its inclusion in the type of *Homo sapiens*.

B. Kanjera No. 1.—(1) This specimen has been reconstructed by Dr. Leakey and Mr. McInnes from numerous fragments. The Committee accepts their association but is not able to exclude the possibility of some distortion of the actual specimen being manifested in the reconstruction. (2) The Committee sees no reason to distinguish between Kanjera No. 1 and No. 3, either in regard to the degree of mineralisation, or in regard to antiquity. (3) The Committee notes that Dr. Leakey's reconstruction and his placing of the two main pieces of the specimen provide a maximum length of 200 mm., and that the mid-sagittal contour is strongly suggestive of that which has been accepted by it as reasonably representative of Kanjera No. 3. (4) The Committee remarks that Kanjera No. 1 does not possess the great thickness seen in Kanjera No. 3, also that the transverse diameters seem to be less in No. 1 than in No. 3. (5) On the whole survey, the Committee is prepared to associate Kanjera No. 1 and No. 3 as possibly female (No. 1) and male (No. 3) representatives of the Kanjera type.

C. Kanam.—(1) The Committee, having examined the fragment of mandible, agrees that the appearance of this specimen is not inconsistent with the high antiquity assigned to it. (2) With the possible exceptions of the thickness of the symphysis, the conformation of the anterior internal surface, and what seems to be a large pulp-cavity of the first right molar tooth, the Committee is not able to point to any detail of the specimen that is incompatible with its inclusion in the type of the *Homo sapiens*. (3) In arriving at this conclusion the Committee has had regard to the conformation of the parts about the chin. It has noted that the incisor teeth show signs of crowding but has detected no indication of unusual size in the canine teeth.

ARCHÆOLOGY

The Archæological Committee, after examining the material exhibited, submitted the following conclusions :—

At Oldoway, in a continuous stratified deposit, which should henceforth rank as a standard section, a worked pebble industry in Bed I is supplemented in the lower part of II by an early Chellean industry with *coup de poing* and rostroid forms : and the pebble types persist for a while. There are indications of continuity and of a gradually evolving technique between the pebble industry and the Chellean technique. In Bed III the 'later' or 'evolved' Chellean passes on into highly evolved Acheulean industry, which becomes fully evolved in Bed IV. Though scraper types, round butt hand-axes, and flake implements occur, they are not dominant at any point in the series.

At Kanam and Kanjera, stratified deposits include a similar series of industries, and therein the Kanam jaw is associated with the pebble industry, and the Kanjera skull fragments with Chellean implements corresponding with those of the upper part of Oldoway II.

The pebble industry of Oldoway I has no precise counterpart in western Europe, but is certainly anterior to the Early Chellean of Bed II. The Early Chellean culture of Bed II at Oldoway corresponds typologically with the industries of Early Pleistocene deposits in western Europe ; and the uppermost industries of Oldoway IV with those of the Thames valley gravels with Acheulean implements. The types from Zambezi gravels and other deposits in South Africa indicate comparable lapse of time.

There is no reason to doubt that the series from East Africa is of at least equal antiquity with the European, and it may even begin somewhat earlier.

The Conference, after detailed discussion of these reports, and of supplementary information furnished by Dr. Leakey and Mr. McInnes as to the circumstances of their discoveries, accepted the reports ; congratulated Dr. Leakey on the exceptional significance of his discoveries ; and expressed the hope that he may be enabled to undertake further researches, seeing that there is no field of archæological inquiry which offers greater prospects for the future. It especially urged the early organisation of another expedition.

The following were present and concurred in the above conclusions :—Sir Arthur Smith Woodward (chairman), A. L. Armstrong, H. Balfour, Miss D. M. A. Bate, P. G. H. Boswell, M. C. Burkitt, V. G. Childe, L. C. G. Clarke, W. L. H. Duckworth, H. J. Fleure, C. Forster Cooper, V. E. Fuchs, A. C. Haddon, A. T. Hopwood, O. T. Jones, Sir Albert Kitson, L. S. B. Leakey, D. McInnes, E. H. Minns, J. Reid Moir, J. L. Myres, T. G. Mollison, F. Oswald, K. S. Sandford, R. A. Smith, W. J. Sollas, J. D. Solomon, Miss M. L. Tildesley and D. M. S. Watson.

Utilisation of Coal

MR. H. T. TIZARD, rector of the Imperial College of Science and Technology, presided at a symposium on the utilisation of coal arranged by the British Science Guild and held at the Royal Institution on March 27. The large audience, which was representative of coal, coal-gas and oil interests, scientific and technical societies, trade unions and members of Parliament, was addressed by Capt. Bernard Acworth, Mr. Stephen Lacey, Eng. Rear-Admiral W. Scott-Hill, and Mr. A. C. Hardy, after which there was a discussion.

In his opening paper on the "Economic Significance of Coal", Capt. Acworth made special reference to legislative differentiation unfavourable to the expansion of the coal and coal-gas industries. He asserted that the chief consumers of oil fuel are heavily subsidised out of the public purse. The British taxpayer pays most of the cost of maintaining aircraft, passenger and goods traffic : the taxpayer has likewise had to pay £1,600,000,000 to make our roads fit for motor traffic, and part of this vast sum is an indirect subsidy to the oil companies as it is spent on oil residuals. In addition, certain public authorities have made compulsory the use of electricity for lighting and heating purposes in subsidised houses.

Although the demand for fuel has greatly increased during the past twenty years, the output of coal in Great Britain has decreased by 67,000,000 tons a year since 1913, this decrease indicating the extent by which imported oil has replaced coal. This replacement is represented over the period by an unfavourable trade balance of £960,000,000 ; and one million unemployed involving an annual public burden of £65,000,000. These facts, he urged, should be taken into account by our legislators in considering the relative costs and advantages of coal and oil as a fuel.

Mr. Stephen Lacey, who dealt with the "Development of the Use of Gas", claimed that the part played by the gas industry as an instrument in the efficient utilisation of coal is invariably under-rated. The carbonising process in gas and coke-oven works is the most efficient known means of converting coal into smokeless fuel and other convenient forms of heat. One ton of coal carbonised in a gas works will supply the same amount of useful heat as two tons of raw coal used either for direct heating or converted into electric energy, but at present only ten per cent of the total amount of coal used in Great Britain is carbonised in gas works as compared with twenty-five per cent of raw coal burnt for domestic purposes. This is indicative of the conservatism which has to be overcome, but progress is being made.

The use of gas for industrial undertakings is increasing, more than half the output of some supply companies being thus utilised: and quite recently successful demonstrations have been made in the use of cylinders of compressed gas for mechanical road vehicles, which opens up a new field of enterprise for the gas industry, for gas possesses advantages over petrol, particularly in connexion with engine-starting and completeness of combustion. The present need is for industrialists to overcome their bias in favour of oil and to modernise their plants to enable them to take advantage of the greater heat efficiency and lower cost of carbonised coal and coal-gas.

In his paper on "Coal for Sea Transport", Rear-Admiral Scott-Hill expressed the view that the use of coal for sea transport must be determined by various factors, only one of which is the actual cost per heat unit of coal as compared with oil. The material we import is greater in bulk than that which we export, and therefore a double economy is effected if our ships carry a home-produced fuel as a source of heat or 'bunkers'. This was the factor which led to the supremacy of the British mercantile marine in the nineteenth century, but it was accompanied by standardisation of ship machinery and a reluctance to apply the results of modern science by designers of ship engines. Consequently the first oil-fired ships worked at an advantage over the stoker-fed coal-burning ships, in addition to which the use of oil makes it possible to reduce greatly the number of firemen, it is clean and its 'bunkering' can be carried out more rapidly and without interfering with other work in and about the ship—great advantages for passenger ships and the Navy. For example, at full-speed a first-class battleship would need 600 stokers if raw coal were used against 200 required for an oil-burning ship. Nevertheless, if modern methods of feeding furnaces are adopted by coal-burning ships, if fuller advantage is taken of pulverised coal or mixed fuels, and if the Government encourages the better utilisation of coal, there is still a future for the use of coal in sea transport.

Mr. A. C. Hardy claimed that, if the wish of the back-to-coal enthusiasts were realised, the British mercantile marine would probably be swept out of economic existence by sheer weight of the operating superiority of its rivals. The inference to be drawn from the great increase in oil-burning and motor ships must be that they have advantages for certain purposes over coal-burning ships. Since 1914, the world tonnage of oil ships has grown from 1½ million tons to nearly 20½ million tons: the motor ships from ½ million to 10 million tons. In the past ten years, however, in spite of the fact that the tonnage of oil ships has doubled, that of coal-burning ships has decreased from 45½ million to 40 million tons.

In any event, the ultimate criterion must be the reduction of fuel cost, to which problem both marine coal-steam and marine oil-steam designers are applying themselves with assiduity and success: both of these have also to reckon with the fuel figure of the marine Diesel designers. Coal consumption per horse-power hour has now been reduced to 1 lb. as compared with the best oil-steam figure of about 0·6 lb. and the best Diesel figure of 0·35 lb. Oil now possesses the advantage that oil-filling stations are more numerous than coaling stations, in addition to the advantages over coal of cleanliness in use, quickness of 'bunkering', ease of stowage, small amount used, lower labour costs on board, and the smaller space occupied by oil-using plant. The real question, he suggested, is whether or not Great Britain is justified in creating a handicap against oil in favour of coal. This, he asserted, can only be done at great expense to the taxpayer and to the ultimate disadvantage of our mercantile marine.

In opening the discussion, Dr. E. F. Armstrong suggested that colliery owners on one hand and the Government on the other must be held partly responsible for the replacement of coal by coal-gas, electricity and oil as a heat source: the former by their tardy recognition of the need for modern methods of coal-getting, the cleaning and classification of coal, care in transport, and their acquiescence in wasteful and obsolete methods of distribution of coal for domestic use: the latter by the adoption of the quota system. Another factor in the decline in the use of coal is the attitude of the coal producers towards their natural allies, the gas and electricity supply companies, both of which are charged excessive prices for coal and both of which in turn add to their own costs a disproportionate and unnecessary burden of advertising charges. Finally, he suggested that Capt. Acworth's plea for a back-to-coal movement would be more effective if he supported instead of attacking expenditure on those researches directed towards obtaining oil from coal, including hydrogenation of coal.

Major F. A. Freeth added that if the coal producers had spent only a small fraction of what Imperial Chemical Industries Ltd. had spent on research and organisation they would not be in their present wretched plight.

Mr. H. Pirie, who followed, said that the coal industry has now realised the need for action on the lines suggested by Dr. Armstrong and Major Freeth. The Coal Utilisation Council which he represented was formed for the purpose of promoting the sale of coal, to which end an intensive propaganda campaign is to be launched. An information bureau has been set up from which both producers and consumers can obtain advice and information, including assistance on technical and scientific matters.

Admiral Willmott-Nicholson expressed his sympathy with the views of Capt. Acworth and laid stress on the strategic importance of Great Britain being independent of imports of fuel in the event of war. Among others who contributed to the discussion were Dr. Ormandy, Mr. Hamilton Gibson and Mr. Zulver.

In summing up, Mr. Tizard warned his audience against falling into the error of associating too closely our increasing imports of oil with the decrease in the use of coal and with unemployment among the mining population. The fact that less coal is now used for domestic consumption is obviously not unconnected with increased efficiency in its use, and taking a long view, this is an advantage to the nation. It is a melancholy reflection that whereas ten years ago our economists and politicians attributed our industrial stagnation to the failure of industrialists to apply science to their undertakings, they now attribute our economic depression to the success with which science has been applied in industry. The fact is that our industrial supremacy during the greater part of the nineteenth century was due to the skill and assiduity with which we applied science and invention to then existing conditions. It is useless to bemoan changed conditions: our task is still to apply our best scientific brains to the world as it is to-day.

University and Educational Intelligence

CAMBRIDGE.—Appointments to three University lectureships in mathematics will be made in the Easter term, to take effect from October 1. The initial basic stipend of a University lecturer is £200 a year but the General Board may grant an additional allowance of £150 a year to a lecturer who is not a fellow of a College and may also grant a number of years seniority carrying with it an increased basic stipend. Candidates are requested to send their names with any evidence of qualification to Mr. M. H. A. Newman, secretary to the Faculty Board of Mathematics, St. John's College, Cambridge, on or before May 6.

The subject proposed for the Adams prize for the period 1933-34 is "The Mathematical Representation of Unsteady Flow in Fluids". Recent experimental researches on fluid flow close to a solid surface have revealed new facts of which no mathematical treatment has yet been given. Other aspects of the subject that might be studied include the stability of the flow of viscous fluids, the statistical treatment of turbulence and the conditions behind a body moving in a fluid. Each essay should be accompanied by a full and careful abstract, pointing out the parts which the author considers to be new and indicating the parts which are regarded as of more importance than the rest. The prize is open to the competition of all persons who have at any time been admitted to a degree in the University. The essays must be sent to the Registrary on or before December 31. The value of the prize is about £268; the value may be increased when it seems desirable to the adjudicators, on occasions when the prize is divided.

LONDON.—The following appointments have recently been made: chair of civil engineering (Imperial College—City and Guilds College), Prof. A. J. S. Pippard, since 1928 professor of civil engineering in the University of Bristol; chair of physics (Birkbeck College), Mr. P. M. S. Blackett, since 1930 a University lecturer at the University of Cambridge; readership in physiology (Guy's Hospital Medical School), Mr. W. R. Spurrell, since 1931 demonstrator of physiology in the University of Leeds; Cassel lecturer in commerce (London School of Economics), Dr. Vera Anstey, since 1929 lecturer in commerce at the London School of Economics.

ST. ANDREWS.—The Senatus has resolved to confer the honorary degree of LL.D. at the graduation ceremony on June 30 upon the following: The Right Honourable Mabell-Frances-Elizabeth, Dowager Countess of Airlie, Airlie Castle, Kirriemuir; Mr. W. St. C. Baddeley, Castle Hale, Painswick, Gloucestershire (antiquarian and archæologist); Dr. R. W. Chapman, secretary to the Delegates of the Oxford University Press; The Right Honourable Viscount Chelmsford, formerly Viceroy of India, Warden of All Souls College, Oxford; Prof. Carl Neuberg, director of the Kaiser Wilhelm Institut für Biochemie, Berlin, and editor of the *Biochemische Zeitschrift*; Mr. R. S. Pearson, director of the Forest Products Research Laboratory, Princes Risborough; Mr. Evelyn C. Shaw, secretary to the Royal Commissioners for the Exhibition of 1851, and honorary general secretary of the British School at Rome.

DOCTORATES conferred in the sciences in American universities have increased steadily in number from 330 in 1919–20 to 1241 in 1931–32. The titles of the theses are published annually in the "Reprint and Circular" series of the National Research Council together with tables of comparative statistics for ten years. The tables show that last year the maximum numbers of doctorates conferred in previous years were exceeded or equalled in chemistry (420), zoology (127), physics (113), mathematics (75), bacteriology (46), pathology (43), physiology (46) and anatomy (16). Psychology (104) takes fourth place in the list of subjects, botany (79) fifth and engineering (47) seventh.

HIGHER education in Sweden is known in Great Britain chiefly by its fruits, the character of which argues excellence in the institutions in which it is conducted. A convenient summary account of those institutions has been published by the United States Government Printing Office as Pamphlet No. 32 of 1932 (10 cents). The author, who is the specialist for western Europe in the Foreign School Systems Division of the Federal Office of Education, has attempted to give such particulars as will enable university registrars to estimate the value of academic credentials of Swedish-trained students and has therefore described the various curricula and examination systems in use, both in the secondary schools and in the four universities and some sixteen other (specialist) institutions of university grade. The important reorganisation of the Swedish national scheme of education described some time ago in the Board of Education's Pamphlet No. 81 (H.M. Stationery Office, 1930) is still proceeding. Another useful pamphlet (No. 29; 1932) issued from the Foreign School Systems division of the Office of Education is a summary of official certificates, diplomas and degrees granted in France. This includes a graph exhibiting the successive stages of primary, secondary and university instruction.

How schools have been affected by the prevailing economic depression is told in the December issue of *School Life*, the organ of the United States Office of Education. Thanks to the traditional esteem which education enjoys in the United States, school budgets were scarcely affected during the first year of the depression, but they have now begun to feel the pinch of hard times, especially those of the rural schools in which there was but little provision for expenditure on more than the bare necessities. In school budgets of cities with populations of more than 100,000, the effect of the all-pervading financial stringency is seen chiefly in the reduction in the current year by nearly forty per cent in provision for capital outlay, but in most of the States outside the New England group and California, far more drastic curtailments have taken place in rural school budgets. These have involved such measures as the adoption of a shorter term, elimination of some of the school services and even the closing of schools. In one State, 26 schools were closed for want of funds for their maintenance; in another the closing of schools in 25 counties is expected to throw five thousand teachers out of employment and the average salary paid to elementary teachers was reduced by twelve per cent without counting reductions entailed by shortening the school term; some counties have dismissed one out of every three teachers.

Calendar of Nature Topics

April Showers

In England, April is proverbially showery. It is the spring month *par excellence*, in which the air is still cool but the sun is already fairly strong. The worst storms of winter are past, and moderate breezes prevail, but the land surface is much warmer than the sea, and the air which crosses our coasts is warmed rapidly by contact with the ground. On a typical April day ascending currents are formed, giving rise to detached cumulus clouds from which showers may fall, but the clouds rarely coalesce to form cumulo-nimbus, for the amount of moisture in the air is insufficient for the development of the more severe thunderstorms which occur under similar conditions in summer. Sometimes in April, showers may be seen to fall from a cloud but evaporate before reaching the ground.

Tornadoes in the United States

April 7.—Tornadoes are violent whirls of air of small diameter; in the United States they are most frequent and most destructive over the great lowlands of the central and upper Mississippi and lower Missouri valleys, where they sometimes cause considerable loss of life. They may occur in any month and at almost any hour, but are most frequent in the afternoons of spring and early summer. Most tornadoes form in the current of warm moist air which blows from the south in front of a cyclonic depression advancing across the continent from the west. Above this warm southerly wind there is often a cool wind from the north, giving an unstable distribution of the air layers. When, in addition, the ground is heated by sunshine, conditions become very favourable for the occurrence of violent readjustments, which are generally associated with severe thunderstorms and in extreme cases take the form of tornadoes.

Immigration of Summer Visiting Birds

An occasional early bird arrives in Britain in February; the chiffchaff, ring-ouzel, wheat-ear, swallow, sand-martin, and garganey duck are all credited with dates in the latter part of the month, although mid-March is their usual time of arrival. Generally speaking, the tide of normal immigration begins with first arrivals in the second week of March, led by the ring-ouzel and the wheat-ear, and in all about fourteen species of summer visitors have put in an appearance before the month is over. But April is the great month of first arrivals and in the third week of the month the greatest number of species appears, about twelve out of the month's total of thirty. The advance guards are followed within a few days by the general immigration of the species, but often a month or more may elapse before the general movement is completed. Amongst the laggards in reaching their breeding haunts in Britain are the red-necked phalarope, which nests in a few localities in Scotland, where it arrives in the third week of May from its winter haunts in the seas of south-western Europe; and the marsh-warbler, which seldom reaches its nesting sites in the southern counties of England until the early days of June.

The mass arrival of the summer visitors amongst birds is associated with the increase of temperature, for it is in April that the great spring change takes place, and the winter type of temperature distribution, in which inland temperatures are relatively low compared with coastal temperatures, is replaced by the summer distribution of high inland and low coastal temperatures, which continues until the autumn.

Order of the Coming of Summer Visitors

When Dr. Eagle Clarke summarised the vast mass of data on migration accumulated for the British Association Committee of 1896, he found that the great majority of British summer birds appeared on the west coast of England some days in advance of their arrival in their eastern haunts. These observations have been amply confirmed, and it has been found, as Dr. Clarke also has pointed out, that the same rule applies to Scotland, where the Solway and Clyde areas receive their first spring migrants some days earlier than the areas of Tweed and Forth. The records and maps of spring migrant isophenes (or lines of equal arrival dates) published in recent years in the Phenological Report of the Royal Meteorological Society, make still more striking the order of the arrival of the summer birds. From south to north the progress is remarkably steady each year. Within a week of the first arrivals in Kent, the birds are at the Humber, three days later they have reached the Tweed, and in approximately three more days they appear in the neighbourhood of Aberdeen.

Another fact, often referred to, is the regularity with which the individuals of a species arrive at the same place year after year, a testimony to the stability of the seasonal impulse of migration the more striking when the enormous distances traversed between the points of setting out and of arrival are kept in mind. A recent example may be quoted from a paper by Witmer Stone in the Year Book of the Academy of Natural Sciences of Philadelphia for 1931 (1932). For many years the Delaware Valley Ornithological Club has recorded the time of arrival of birds at various places within ten miles of Philadelphia; two examples of their records will illustrate the point—in eight consecutive years the wood-thrush has arrived on April 28, May 2, April 30, April 28, April 29, May 1, April 26 and May 1; and the black-and-white warbler on April 27, 26, 25, 27, 27, 27, 25 and 27. Both birds are easily recognisable, one by its song the other by its coloration, so that there is little chance of either being overlooked or mistaken for another species.

The 'March Brown' of the Angler

The 'March brown', now appearing in great quantity in a number of rivers, is widely distributed in Britain. Well known to the angler for more than a century by its common name of 'March brown' and by other names since the middle of the seventeenth century, it is extremely probable that the 'March brown' is referred to in a well-known description in the "Boke of St. Albans" (1496). It is curious that such a familiar insect should so long have remained unknown to the entomologist, and only recently have found its rightful place in the list of British Ephemeroptera. Eaton (1883) identified it with *Ecdyurus venosus*, an ephemerid different in habits, appearing from mid-May to October, the subimago of which closely resembles the March brown. Moseley (*Ann. Mag. Nat. Hist.*, Jan., 1932) showed the 'March brown' of the early spring months to be *Rhithrogena haarupi*, Esb.-Peters., an insect first described from Denmark (Esben-Petersen, 1909).

Societies and Academies

London

Royal Society, March 23. G. I. Finch and A. G. Quarrell: The structure of magnesium, zinc and aluminium films. An electron diffraction camera is described in which the specimen is swept by a diffuse beam of electrons, thereby reducing the risk of injury to the specimen. The beam is then focused electromagnetically. Oxide-free surfaces of magnesium, zinc, and aluminium on a platinum substrate, also vapours of these metals in transit between source and receiver, were obtained and examined by electron diffraction. The oxides of magnesium and zinc formed on the corresponding metal surfaces have also been examined. It is concluded from the results that (1) the abnormal crystal structures are caused by pseudomorphic strain effects whereby the substrate influences the positions taken up by the atoms of the metal or metal oxide layers formed thereon; (2) such pseudomorphic effects are no longer evident at the surface of sufficiently thick films; (3) for aluminium the pseudomorphic strain effects are confined to the two dimensions of the basal planes, because no such effect was to be observed in the third dimension; (4) magnesium, zinc and aluminium vapours are monatomic. E. C. Pollard: Experiments on the protons produced in the artificial disintegration of the nitrogen nucleus. Experiments to determine the manner of entry of the α-particle into the nitrogen nucleus have been made; these indicate that entry is in general over the top of the barrier, and the height of this barrier is fixed as between $4·1 \times 10^6$ and $4·4 \times 10^6$ electron volts. Further investigation of the absorption curve of the protons confirms the work of Steudel on this element and gives an indication of a second group, which can be ascribed to resonance entry of an α-particle of $3·5 \times 10^6$ electron volts energy.

Geological Society, Jan. 11. C. S. Hitchen: The Skiddaw granite and its residual products. The Skiddaw granite occurs as three isolated, though neighbouring exposures of limited size in the fell country to the north-east of Keswick in the English Lake District. The most southerly exposure occurs at Sinen Gill. It is of the nature of a small apophysis and consists of a porphyritic oligoclase-biotite-granite corresponding to a sub-acid alkali-lime type. The granite of this exposure appears to represent a deep-seated term in the Skiddaw suite. The central and largest exposure occupies an area of about half a square mile and is situated in the valley of the River Caldew. It consists of an albite-muscovite-biotite-granite of a more normal alkali (soda-potash) type, the porphyritic character being less distinct than that of the Sinen Gill rock. The northern exposure at Grainsgill is approximately one-eighth of a square mile in area and appears to be a large apophysis. It consists partly of normal granite and partly of a quartz-mica rock or greisen. It is concluded that the greisen was not formed by the consolidation of mother-liquor extruded from the crystallising magma by crustal disturbances, as was formerly supposed, but that it represents normal granite which has undergone alteration by paulopost hydrothermal solutions. L. G. Anniss: The Upper Devonian rocks of the Chudleigh area, South Devon. The Devonian rocks occur as a number of small, scattered inliers in a region mainly occupied by Lower Culm Measures. The outcrops of Massive Limestone are described, and the Upper Frasnian and the Famennian have been zoned by the cephalopod and other faunas. The Dunscombe beds represent the Manticoceras stage and the base of the Cheiloceras stage (zones 1α to 2α of Wedekind), the Lævigites Limestone and shales represent the Lævigites stage (zone 5), and the Entomis Shales are equivalent to the Gattendorfia stage (zone 6). The succession is not complete, there being a non-sequence between the base of the Cheiloceras stage and the Lævigites stage. The region has been subjected to three distinct earth-movements.

Paris

Academy of Sciences, Feb. 13 (*C.R.*, **196**, 449–512). J. Costantin: Historical résumé concerning conceptions on the degenerescence of cultivated plants. E. Mathias: Contribution to the study of fulminating material. The evaluation of the constant ratio which exists between the final volume and the initial volume in the progressive decomposition at atmospheric pressure when the final temperature is identical with the initial temperature. W. Slebodzinski: The complexes of geodesics in a variety V_3. Alfred Rosenblatt: The theorems of M. Picard in the theory of non-linear partial differential equations of the elliptic type. Paul Lévy: The absolute convergence of Fourier's series. E. Kogbetliantz: The determination of the step $D(x_0)$ of $f(x)$. E. Crausse and J. Baubiac: A modification of the chronophotographic method and some applications. Results obtained by the cinematographic method described were compared with those given by two other experimental methods, hot wire and stroboscopic, and also with the theoretical curve obtained by Szymanski. R. Bossuet: The photographic sensibility of the lines of the alkaline metals in the oxyacetylene flame. Rods of magnesium pyrophosphate were impregnated with the solutions examined at increasing dilutions. Two forms of spectrograph were employed (Féry, Bourguel) and data are given for the limiting sensibilities with lithium, sodium, potassium, rubidium and cæsium. G. Déjardin and R. Latarjet: The spectral sensibility of photoelectric cathodes coated with a cæsium oxide film. Details of the method of preparing the coating and curves of emission as a function of the wave-length. Mlle. Quintin: Study of the electromotive force of the chain: copper, copper sulphate, mercurous sulphate, mercury, at 25° C. The experimental values, used to determine the normal potential E_0 by Lewis's method, do not give a satisfactory extrapolation. René Audubert: The differentiation of the electronic effects and the photoelectric effects in photovoltaic elements. The study of the photovoltaic effects for several frequencies allows, by suitable choice of electrolytes, of distinguishing in the action of light on the electrodes the photoelectrochemical effect from a secondary internal electronic effect. H. Muraour and G. Aunis: The laws of combustion of mixtures of (gun-cotton) powders. F. Bourion and Mlle. O. Hun: The cryoscopy of paraldehyde, acetone and ether in solutions of magnesium and ammonium sulphates. René Dufour: The initial electrolytic overvoltage in the disengagement of hydrogen on mercury. The study of the electrolytic overvoltage of mercury, placed under conditions of reversible equilibrium, appears to lead to the result that the initial overvoltage is nil. Jean Bouchard: The quantitative study of the inhibiting action of some ions on the fluorescent power of uranine. R. Rambaud: Trans γ-oxycrotonic acid. The trans form has been obtained by the complete saponification of ethyl acetoxycrotonate by warm aqueous potash solution. It is stable and does not give a lactone on dehydration. G. Darzens and Maxence Meyer: A new general method for the synthesis of aldehydes. The halogen compound RX is treated with the sodium derivative of ethoxymalonic ester, the latter being readily prepared by the method of Wislicenus, followed by saponification, distillation in a vacuum giving the ester $RCH(OC_2H_5)(CO_2H)$. From the latter the aldehyde RCHO is readily obtained by the method already described by Darzens and Lévy. Examples of the generality of the proposed method are given. D. Ivanoff and I. Abdouloff: *The velocity of disengagement of hydrocarbons produced by the action of indene on fatty organomagnesium derivatives.* A method of measuring the strength of linkage of alkyl radicals with the magnesyl group. L. Berthois: The study of contact metamorphism with the aid of heavy minerals. The method proposed has some advantages over the usual method of thin sections owing to the larger quantities used. P. Fallot: The Xauen massif (Spanish Rif). L. Joleaud and J. Lombard: Quaternary mammals of Ounianga Kebir (South-eastern Tibesti). Marcel Chopin: The influence of the medium on the baking value of bread. Emile F. Terroine, P. Mezincesco and Mlle. Simone Valla: *Utilisation of sulphur and nitrogen from cystine at the level of endogenous protein metabolism.* The addition of cystine to the diet proves that there is no necessary parallelism, in all circumstances, between the metabolism of nitrogen and that of sulphur. The facts cited lend fresh support to the view according to which the protein needs of the organism should be divided into many fractions to a great extent independent. O. V. Amann and Mlle. Gilberte Mourot: The comparative excretion of neutral sulphur in endogenous and exogenous nitrogen metabolisms and its signification. Mme. Andrée Drilhon: Glucose and shedding the shell of crustaceans. At the time the shell is being changed there is a marked increase in the proportion of glucose in the blood. J. Laigret: The sensibility of certain wild mice to the virus of yellow fever.

GENEVA

Society of Physics and Natural History, Feb. 2. W. Schopfer: *Biometric researches on the spores of Mucor.* The measurements carried out on thirteen pairs of strains of *Phycomyces blackesleanus* genetically related between themselves showed that the dimensional characters of the spores (length, coefficient of variability) are not connected with sex. E. Friedheim: The biological signification of melanogenesis. *The biological signification of melanogenesis* is not only in its final product, melanine, but also in an intermediate product, the 'red body', which is a reversible oxidation-reduction system in the thermodynamical sense and functions as a catalyst in cell respiration. P. Rossier: The influence of the absolute magnitude of a star on the *width of the lines of stellar hydrogen.* The relative widths of the lines are independent of the absolute magnitude, whilst the total width of the three lines $H\gamma$, $H\delta$, and $H + H_\epsilon$ increases with the absolute magnitude. G. Tiercy: Note on the respective phases of ionisation maxima and light maxima in a Cepheid. By the combination of the light curve and the curve of radial velocities (or that of pulsation) the present note tends to justify the view that the phase of maximum ionisation (youngest spectrum) precedes the maximum of light. Wakker: Gold-bearing strata of the region of St.-Yrieix (Haute-Vienne). The author describes the deposits as well as the geology of the region and suggests an explanation of their genesis. He studies in detail the Fagassière deposits, those of Tournerie and Ladignac, which are constituted of mineralised quartz veins traversing a granite-gneiss complex.

ROME

Royal National Academy of the Lincei, Nov. 20. U. Cisotti: Translo-circulatory plane current investing an indefinite rectilinear rod: dynamic actions. A. Bemporad: Proper motions and orbital motions resulting from the Astrographic Catalogue of Catania. E. Almansi: The deformations of elastic plates (1). Giuseppina Biggiogero: Geometric views on tensors. Certain questions of tensorial calculation are considered with the help of hyperspacial geometry. R. Caccioppoli: A principle of inversion for functional correspondences and its applications to equations with partial derivatives (2). B. Finzi: Group velocity for waves associated with phenomena. M. Kourensky: Integration of equations to the partial derivatives of the second order with two functions of two independent variables. (2) Systems containing five derivatives of the second order. U. Barbieri: Astronomical-geodetic station at the trigonometrical apex of the first order of Mount Crea in July 1930. Results are given of determinations of azimuth, longitude, etc. R. Zoja: Distribution of the tensions in a solid with a rectilinear axis and a *rectangular transverse section* (4). A particular case is considered in the light of the solutions previously obtained. C. Antoniani: Investigations in the phytosterol group. (2) The sterols of rice husk. A laevo-rotatory sterol, $C_{27}H_{46}O$, melting at 143°, has been isolated from rice husk. The sterol fractions described by Anderson and Nobenhauer (1926) as phytosterol *B*, *C*, and *D* are not definite compounds, but mixtures of the sterol now described with the corresponding dihydro-derivative. A. Baroni: Protoselenosulphochloride. This compound, $SeSCl_2$, obtained by the action of selenium on sulphur monochloride, is a deep-red liquid, boiling at 60°–62° under 20 mm. pressure. It exerts a very rapid vulcanising action on rubber and with colza oil or with carbon disulphide and castor oil it causes instantaneous coagulation. Its action on piperidine results in the formation of monothiopiperidine and the separation of selenium; hence its formula is probably $Se : S : Cl_2$. Nicoletta Sabatucci: The toxic action and elimination of nicotine. (1) *Toxic action of nicotine and oxynicotine.* For a frog weighing 20 gm., the minimum toxic dose of nicotine capable of producing complete paralysis, followed by recovery after a few hours, is 1·2 mgm., and the minimal lethal dose 3 mgm. The lower toxity of oxynicotine, for which the minimal lethal dose is 15 mgm., shows that the toxic action of nicotine depends, at least partly, on the chemical function blocked by the oxygen. (2) Elimination and cutaneous absorption of nicotine and caffeine. If, after administration of nicotine by subcutaneous injection, a frog is immediately placed in 200 c.c. of water, the minimum lethal dose falls, from 3 mgm. with non-immersion, to 1·5 mgm. If, however, the alkaloid is introduced into 200 c.c. of water, the minimum lethal dose is 3 mgm. Similar results are shown with caffeine. The frog evidently manifests a special affinity for the two alkaloids. M. **Mitolo**: Avitaminosis and intoxication. (2) Experimental scurvy and chemical intoxication by metals and metalloids. Ingestion, by a guinea-pig suffering from avitaminosis-C, of mixtures of salts of metals and metalloids in doses non-toxic to normal animals, enhances and accelerates the effect of the food-deficiency.

Forthcoming Events

Saturday, April 1

Royal Institution, at 3.—Developments in Cinematography: A Display of Films, (3) Films in Relation to Aeronautical Research.

Monday, April 3

Royal Geographical Society, at 8.30.—Rev. W. H. Murray Walton: "Among the Mountains and Head-Hunters of Formosa".

Tuesday, April 4

Royal Agricultural College, Cirencester.—Conference on: "The Breeding of Dairy Cattle".

Thursday, April 6

Chemical Society, at 8.—Commemoration of the Bicentenary of Priestley. Papers by Prof. A. N. Meldrum, Sir Philip Hartog and Sir Harold Hartley.

Saturday, April 8

Gilbert White Fellowship, at 2.30—(Annual General Meeting in the Hall of the Art-Worker's Guild, 6, Queen Square, W.C.1).—At 3, Sir John Russell: "Modern Trends in Agricultural Science".

Institution of Naval Architects, April 5–7. (in the Lecture Hall of the Royal Society of Arts, John Street, Adelphi, W.C.2).—Annual Meeting.

Official Publications Received

GREAT BRITAIN AND IRELAND

The Science Masters' Association. Report for 1932, with List of Members (correct to January 1, 1933), Statement of Accounts and Report of Business Meeting. Pp. 96. (Eton College.)

Liverpool Observatory and Tidal Institute. Annual Report 1932. Pp. 15. (Liverpool.)

Linen Industry Research Association. Report of the Thirteenth Annual General Meeting, December 12, 1932. Pp. 14. (Lambeg.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 6 (New Series), No. 1, January. Abstracts Nos. 1–193. Pp. 36. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

London School of Hygiene and Tropical Medicine. Hand-List of Periodicals in the Library. Second edition. Pp. 44. (London.) 1*s*. 3*d*.

Proceedings of the Royal Society. Series A, Vol. 139, No. A839, March 3. Pp. 475–730. (London: Harrison and Sons, Ltd.) 12*s*.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 72, No. 435, March. Pp. 189–268+xvi. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

University of Bristol. Annual Report of Council to Court, Session 1931–32. Pp. 45. (Bristol.)

The British Mycological Society. Transactions. Edited by J. Ramsbottom, B. F. Barnes and H. Wormald. Vol. 17, Part 4, 18 March. Pp. 237–371. (London: Cambridge University Press.) 7*s*. 6*d*.

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Knowledge and Action

THE disproportion between poverty and unemployment and the abundance made possible by power production is leading men everywhere to question the basis of a political and economic system which permits the existence of such a paradox of maldistribution. It is no longer merely a question whether effective measures could be taken if those in authority possessed sufficient knowledge and understanding of the situation, but whether the present system permits them to take any effective action without the whole system being radically reformed. The non-success which has thus far attended the efforts or pleadings of politicians is not only fast breeding a general distrust of their policies but also a disposition to consider far-reaching changes in the structure of society.

A resolution brought forward a short time ago by Lord Melchett in the House of Lords summarises fairly concisely one such point of view:

> "Since under modern scientific conditions productive capacity is unlimited, and since the existence of indigence and unemployment throughout a large portion of the population demonstrates the fact that the present monetary system is obsolete and a hindrance to the efficient production and distribution of goods, in the opinion of this House the Government should bring forward immediate proposals for the economic reforms necessary to enable the subjects of this realm to enjoy the benefits to which their present productive capacity entitles them."

The significance of this resolution lies not in its premises, which might be challenged on both sides, but in the very fact of such proposals being debated in our Second Chamber. That such a challenge to our monetary system, coupled with a plea for the national planning of industrial development, limitation of profits and evolution of a characteristic national economy modelled neither on Fascist nor Soviet lines could seriously have been made in such place would have seemed incredible but a couple of decades ago.

It is idle to ignore the fact that the ordinary citizen is beginning seriously to consider the question why politics have proved so unsuccessful where science has had such great success, and if politicians persist in asserting that a radical change cannot be produced in our existing structure of society, he will be liable to retort: "So much the worse for that structure." In a recent address to the Manchester Literary and Philosophical

Society, Sir Ernest Simon expressed the opinion that the only way of providing a solution to our present problems is by scientific thought and by the application of reason to politics. Research into economic and political affairs on just such scientific lines as are applied to physics is essential and yet in Great Britain such research is almost non-existent. Sir Ernest also endorsed Prof. W. McDougall's plea that research on the physical sciences should largely be diverted to research on economic and political questions.

Evidence of the truth of these observations can easily be found in current affairs. The Salter Report on road and rail transport for example was rushed to a decision in July last but no definite action has yet been taken, and interests which are adversely affected are still able to maintain a barrage of criticism to the first steps which Sir Arthur Salter and his colleagues indicated as urgently required. This, of course, is a typical example of the effect of unscientific and rigid legislation which allows unforeseen situations to create formidable vested interests before they are tackled.

Similarly, the hiatus between action and knowledge in spite of all the lip service to the doctrine of national planning is well illustrated by the position of the textile industries in Lancashire. Through the activities of the Universities of Manchester and Liverpool, the Cotton Trade Statistical Bureau, the Manchester Chamber of Commerce and the various regional planning committees, Lancashire is probably the most completely surveyed area in Great Britain. Lancashire opinion has not been mobilised, however, and the chaotic condition of the cotton industry robs it of any power to influence national policy. We are still without any organisation filling the gap between the type of financial assistance supplied by the city and that required by industry to modernise its plant and improve its marketing organisation, as the chairman of the Lancashire Industrial Development Council, Mr. T. D. Barlow, has pointed out in a letter to the Prime Minister.

On the further plea for Government control and guidance of new industrial enterprise to avoid economic waste, the developments in the canning industry accentuate the need for national policy and action. The rapid erection of new canneries while the majority of those in existence are working at only half capacity jeopardises all planned development for canning, and this new industry, which had every opportunity of starting with a clean slate and avoiding the mistakes which have handicapped the growth of other such industries, is threatened with similar loss of capital and general discouragement through low prices.

It is unnecessary to multiply examples of the imperative need of decisive Government action allied to adequate knowledge in accordance with some deliberate plea on scientific lines, though even more striking evidence could be advanced from the international sphere—disarmament, the tariff situation, Manchuria. However, it is as well to recall that the present position is not entirely novel and differs more in degree than in character from that pointed out by such an acute observer as Walter Bagehot more than half a century ago. Writing in "Physics and Politics", he notes as one mark of advancing civilisation "a diffused disposition to weigh evidence, a conviction that much may be said on every side of everything which the elder and more fanatic ages of the world wanted". To those who urged that not only did committees and parliaments fail to act with rapid decisiveness but also that no one now so acts, he replied that when we have a definite end in view, which we know we want, and which we think we know how to obtain, we can act well enough.

Bagehot's argument that the check which deliberation and discussion have placed on irrational impulse and hasty action is an untold benefit to humanity is further supported by his reminder that the impatience and excessive activity of man is one reason why science came so late into the world and is so small and scanty still in its influence. In the half-century since he wrote, however, the difficulty of relating action to knowledge has become far more acute. Not only is much more demanded of the statesman, administrator and politician, but more also is asked of the electorate. It has to be recognised that frequently public opinion, as Sir Ernest Simon pointed out, will not permit the Government to take right action. To quote a recent address by Lord Irwin : "the democratic State depends ultimately on the average judgment of its average members and it should be one of the main objects of education not to conduct mass propaganda but to win for the young the gift of right judgment in all things and the power to distinguish in public affairs and policy between the genuine coins and the spurious counterfeits".

The misgivings regarding the future of democracy which have been expressed by General Smuts, Mr. H. G. Wells and others are largely prompted by the experience of the power of democracy revealed in the last ten years and the danger of prejudices and passions being inflamed, amid which only the demagogue and not the statesman can gain a hearing. For the selection of the right kind of representatives in this scientific age an educated electorate is essential—informed, honest, public-spirited voters capable of electing representatives qualified by knowledge as well as by eloquence, and capable of trusting their representatives to deal with the problems and situations confronting them.

The enthronement of reason in politics outlined in Sir Arthur Salter's ideas, as in Lord Melchett's or Capt. Harold Macmillan's suggestions for an industrial parliament, involve nothing less than a revolution in democracy. While, however, there is much ground for misgivings in recent history alike in Great Britain and in the United States, there are also hopeful signs to be found of the coming of a new order.

Inadequate as the distribution of leisure at the present time may be, the extent of leisure in the modern world is growing and assuming an increasing importance in the life of each individual. The opportunities for education and for forming an intelligent opinion upon public affairs are multiplying and are being increasingly used, even if there is ample room for improvement. On the other hand, there is already an increasing disposition to experiment in our social and private lives, a sufficiently pronounced tendency to be described by Dr. C. Delisle Burns as the most important social change of the past fifty years.

This readiness to experiment is already disposing many to face the break from traditional methods or outlooks, if thereby there is any reasonable hope of redressing the balance in the present distribution of leisure and work, productive capacity and consumption. There are welcome signs of a new attitude towards science and an increasing disposition both to try new methods and to insist on the relation of administrative or executive power with full knowledge of the technical or scientific issues. The increasing efficiency of the instruments of social change is a further hopeful factor. What is in doubt is whether the progressive forces can be organised sufficiently rapidly for effective action; before the continued misuse, either in industry or in politics, of the immensely greater destructive forces released by the application of scientific discoveries, involves us in irremediable social or economic disaster. The support of scientific workers is an indispensable factor in safeguarding society, and its effective mobilisation is long overdue.

De Sitter's World

Kosmos: a Course of Six Lectures on the Development of our Insight into the Structure of the Universe, delivered for the Lowell Institute in Boston in November 1931. By Prof. W. de Sitter. Pp. xii + 138 + 12 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1932.) 9*s.* 6*d.* net.

THIS book affords the world an opportunity of knowing Prof. de Sitter for what his many friends have long known him to be, a great lover of science and a great lover of art. De Sitter speaks to the English-speaking peoples in a tongue which is not his own by birth, but which he uses with an unstrained eloquence that brings vivid pleasure. He does so by right of his own distinguished contributions to a great subject; and he conceals his weight of technical learning under an appealing simplicity of diction. In these lectures not only astronomers and astrophysicists but also all inquirers after knowledge are shown plainly what de Sitter thinks about the world and why he thinks it worth while to go on thinking about the world. We have here no attempt to stun the reader by force of huge distances, no attempt to drug him with doses of inconceivable periods of time. The book gives the real reasons why men working at astronomical science have drawn the picture as they present it to-day.

The lectures are in form a historical account of astronomical discovery. They deal with the Ptolemaic and Copernican systems, with the great work of Kepler, Galileo and Newton, with the first ideas of the sidereal system developed by William Herschel, with Kapteyn's masterly statistical synthesis of modern observations of what we must now call the nearer stars, with a picture of the galactic system as a whole as expressed in the work of Shapley, J. S. Plaskett, Oort and others, and lastly with the great problem of the expanding universe of spiral nebulæ.

The solar system is definite enough. But the 'local cluster' and the galactic system are, one a convenient working hypothesis for certain purposes and the other a largely unknown monster. Perhaps all will not accept every detail of the picture as painted by de Sitter. It is not certain that a galactic rotation is the only legitimate interpretation of the observed double wave in the radial velocities and proper motions; the evidence for the local cluster is hard to reconcile with galactic rotation; and the phenomenon of star-streaming has not been adequately fitted in to the scheme. These points are discussed by de Sitter in a stimulating way.

Most readers will reserve their greatest interest for de Sitter's handling of the problem to which he has himself notably contributed—the structure of the world of nebulæ as 'smoothed-out'.

Here we must examine both de Sitter's philosophy of science and his present attitude to the problem. De Sitter says that the ultimate aim of science is to discover as much as is discoverable about the reality behind the phenomena. Surely this is not the aim of science, whatever may be the aim of philosophy. De Sitter defends his view by urging that "the laws of nature, after all that is relative, due to the observer, has been eliminated, *are* for us the reality". Again, later, he says, "the development of science is in the direction to make it less subjective, to separate the observed facts from that which belongs to the reality behind the phenomena, the absolute, from the subjective element which is introduced by the observer, the relative. Einstein's theory is a great step in that direction. We can say that the theory of relativity is intended to remove entirely the relative and exhibit the pure absolute".

The reviewer would ask whether the aim of eliminating the observer is in the last resort a legitimate one. In atomic phenomena, the measurements of times and energies, of positions and velocities, have been shown to be related by Heisenberg's uncertainty principle, so that there the act of observation itself cannot be eliminated. In macroscopic phenomena, the observer is eliminated by the construction of 'space-time'. Einstein's special theory of relativity did not abolish the observer: it correlated the observations of two observers in uniform motion. Minkowski showed how these different observations could be welded together into a set of world-lines in space-time. But this does not justify us in assuming space-time to be the real stuff of which the world is made, for that there exists a reality independent of the observer is a pure postulate. Science is concerned with the class or aggregate of all observers' observed worlds, and not with some hypothetical temporo-spatial structure behind them. For each separate observer, the complete time-sequence of his world-views is for him the reality.

The hypothesis that 'space-time' is an element of the real nature of the physical world is deep-rooted in most treatments of the cosmological problem. De Sitter says, "We have no intuitive knowledge of the kind of space we live in. As we are concerned with *physical* space. . . ." Thus he assumes that there is a real existent, 'space', a constituent of the world, capable of being explored. What the properties of the existent space may be has recently been the subject of detailed inquiry by O. Heckmann, de Sitter and Einstein. It has been shown that solutions of the gravitational field equations for the world may be obtained for space of positive, zero or negative curvature, and that various laws of gravitation, with and without the famous λ-term, may be employed. De Sitter has shown (and he emphasises in "Kosmos") that we shall never be able to say anything about the curvature of space without introducing certain hypotheses. This seems to make it doubtful whether the phrase 'physical space' has any objective content at all. If its curvature can never be ascertained, if its curvature is essentially unobservable, then 'physical space' is essentially an arbitrary thing chosen for convenience in describing the world and capable of being chosen in different ways. We are fully entitled, for example, to choose ordinary Euclidean space. This was the point of view of Poincaré. We must, of course, recognise that different ways of choosing space will lead to different forms of expression of the same physical laws. This is illustrated by the inter-relationship shown by Heckmann and de Sitter to exist between the assumed sign of the curvature of space, the assumed sign of the λ-term and the observable quantities, namely the mean density of space and the rate of recession of the nebulæ.

De Sitter concludes that the theory of the expanding universe is at the present moment much less definite than it used to be. "We do not even know whether the curvature is positive, zero or negative, whether the universe is finite or infinite." It would appear preferable to say that questions as to the curvature have no objective content, for the answer is within the analyser's choice, but that questions as to the finiteness of mass or finiteness of volume of the universe have an objective content and are capable of answer either by extended observation or by the application of general principles. De Sitter reminds his readers that the conclusions derived about the expanding universe depend on an assumed homogeneity and isotropy, and that it is not inconceivable that this hypothesis may have to be given up, or modified, or differently interpreted. The uncertainties in the present views on the structure of the universe seem thus to arise out of the assumption of an underlying reality, space-time, and the assumption of homogeneity. De Sitter's last judgment is that our conception of the present state of the universe bears all the marks of a transitory structure. His account of the problem may be commended as a highly objective and dispassionate scientific study, free from all mysticism, possibly the best account available.

E. A. M.

Further Light on the Schneider Mediumship

National Laboratory of Psychical Research. Bulletin 4: An Account of some Further Experiments with Rudi Schneider; a Minute-by-Minute Record of 27 Séances. By Harry Price. Pp. 199+23 plates. (London: National Laboratory of Psychical Research, 1933.) 10*s*. net.

THIS book is a vivid account of a series of sittings held in 1932 under the auspices of the National Laboratory of Psychical Research, an organisation directed by Mr. Harry Price and supported by a number of people interested in the subject, such as Dr. Hans Driesch, Prof. William McDougall, Prof. J. C. Flügel, Dr. R. J. Tillyard and Dr. Eugène Osty. The medium under investigation was Mr. Rudi Schneider, who has already been the subject of several books, of which one, concerning recent developments, was reviewed in these columns on June 25, 1932. It is as a supplement to that work that the present volume is especially interesting.

The problem of the Schneider brothers and of their mediumship has for long excited the most embittered controversy. Suspicions have been freely ventilated, but it was not until about 1925 that light began to be apparent. It was suggested that in order to describe the phenomena in normal terms the use of a confederate must be assumed. In order to test this hypothesis Mr. Warren J. Vinton, an American observer and a former colleague of Dr. E. J. Dingwall in the latter's private inquiry into the phenomena of Mr. Willi Schneider, visited the Schneider family in Austria, and in his report describes the methods used by the brothers in their séances. He states that he came into contact with what seemed to be a figure crouching behind the medium's chair; and, in a brief but brilliant analysis, shows how the phenomena could be roughly divided into two main classes—those produced with the aid of a confederate and those produced by the surreptitious freeing of one hand from the control.

In 1927 the use of the confederate was studied by an official of the American Society for Psychical Research who was previously highly unsympathetic to the theories evolved by Dr. Dingwall and Mr. Vinton, but who later admitted in his report that all the essentials of that theory were verified and all the conditions required for its fulfilment were reproduced.

In 1929 and in 1930 further experiments were conducted by Mr. Price in London. Striking phenomena were recorded and again it seemed clear that, if the manifestations were normally produced, confederacy must be assumed.

In 1931 and 1932 Mr. Rudi Schneider was in Paris under Dr. Eugène Osty, the Director of the Institut Métapsychique and a vice-president of Mr. Price's organisation. A series of remarkable phenomena was recorded. It was alleged that the medium possessed the power of externalising a 'force' or 'substance' which demonstrated its presence by interrupting infra-red rays. The report was received with considerable interest in scientific circles, although the record, as printed, lacked many details wholly necessary to a proper understanding of Dr. Osty's methods. Further light is now shed upon these by Mr. Price, who reveals the fact that Dr. Osty was aware of the presence of a confederate in his own laboratory, whilst omitting this significant fact in the official report of the sittings held at the Institut.

The present work carries the inquiries a step further. It does more than that. It gives as intimate a glimpse of the conditions obtaining at 'scientific' inquiries as Mr. Vinton's report gave of the conditions in the Schneiders' own home. The ear-deafening uproar: the forced gaiety of the observers: the attempts to distract the attention and to stifle every sense: the groaning and panting of the medium and the occasional screams of the sitters—all the features which make up these exasperating inquiries are found faithfully recorded in these graphic records.

On one occasion a photograph was taken in which the left hand of Mr. Rudi Schneider is seen, freed from the control and stretching backwards towards the cabinet curtains. This is the first piece of photographic evidence illustrating this manœuvre, although its constant occurrence has been suspected for many years. In another photograph Mr. Willi Schneider is shown in the early stages of his 'mediumship' in the process of demonstrating an alleged materialisation attached to a curtain by a safety-pin!

As regards the supposed psychic interruption of infra-red rays as recorded by Dr. Osty, Mr. Price states that, although results were obtained with one piece of apparatus, with another much more sensitive instrument supervised by officials from the Radiovisor (Parent) Co., Ltd., no abnormal changes whatever were registered.

Such are the new facts in the history of the Schneider mediumship. The theories of confederacy and the freeing of one hand from the control have both received further support; and nothing of any importance has been added to indicate that Mr. Rudi Schneider possesses any supernormal faculties whatever.

Francis Bacon

Francis Bacon: a Biography. By Mary Sturt. Pp. xvi + 246 + 12 plates. (London: Kegan Paul and Co., Ltd., 1932.) 10*s.* 6*d.* net.

IT is many years since we were last given a life of Francis Bacon and in the interval science has come to play an essential part in the very machinery of the State as in its structure and every-day business. We have reached a stage in the world's development when its continued progress demands that the man of science assume those ruling functions which Bacon portrayed him as exercising in the "New Atlantis". While, therefore, the "Novum Organum", the "Advancement of Learning" and the exquisite fragment the "New Atlantis" have a meaning for us which the Victorian age could scarcely have sensed, the general impression of Bacon is derived largely from his own essays, coloured by Macaulay's brilliant but unbalanced polemic.

In the present volume, Miss Sturt endeavours to restore the balance and set the figure of Francis Bacon in a true perspective against the passions and prejudices, the schemings and struggles for power in the midst of which he moved for fully forty years. The story is indifferently told and the biographical material is second-hand, but we see the essential Bacon as he may have appeared to his contemporaries—cold, always old for his years, ambitious, indefatigably industrious, shrewd and competent; a man whose talents inevitably led him to the highest legal office, yet much more than the mere lawyer, for his interests extended to literature, to philosophy, to the theory of science, to gardening; and whatever he touched he adorned.

The pageantry of Elizabethan and Stuart life against which Miss Sturt sets her subject is apt to distract or confuse the mind, but the book gives a popular version of Spedding's work which, if disdained by the scholar, should be of value to the general reader.

From the point of view of the scientific worker, the space devoted to Bacon as a philosopher of science is all too meagre. A skilful exposition of Bacon's contribution to the philosophy of science should indeed be of value in the present age when every laboratory might be decorated with his texts and every international society turn to him for a motto. Of Bacon as a philosopher Miss Sturt writes with sympathy and insight, but a brief, popular exposition of his views on science as set forth in the "Advancement of Learning", in the "Novum Organum" and in the "New Atlantis", so sadly neglected by most scientific workers, is long overdue. Even the brief outline contained in the present work, however, should serve as a timely reminder of Bacon's place as one of the true prophets of modern science and induce scientific workers to consider anew his attempt to formulate a technique of discovery, and his vision of a State where the man of science is ruler and where knowledge is harnessed to man's needs.

This vision, born of Bacon's closing years of adversity—he died on April 6, 1626—has the human qualities so often disregarded in ideal commonwealths, and reveals Bacon as one who first in the modern world looked full at facts. To him there was no sphere of life to which scientific thought did not penetrate and he saw too that the scientific method did not rob life of its human values. This vision and the balance of his mind suggest indeed that it is perhaps to a combination of the legal mind trained to assess values, and the scientific mind with its capacity to explore the facts, that we must look for the quality of mind demanded of leaders in the modern State, of whom Francis Bacon himself is both forerunner and type.

R. B.

Short Reviews

Before and After Socrates. By Prof. F. M. Cornford. Pp. x+113. (Cambridge: At the University Press, 1932.) 4*s.* 6*d.* net.

The elementary character of these lectures scarcely veils the scholarly and human vision of Greek philosophy, hinted at by Prof. Cornford. Taking Socrates as the central figure of Greek philosophy, he describes how the early Ionian science failed to satisfy him, and how the systems of Plato and Aristotle attempt to carry into the interpretations of the world the consequences of Socrates' discovery. The reading of Prof. Cornford's book adds to one's conviction that the fundamental problems of knowledge, as treated by the Greeks, bear a strange resemblance to the major preoccupations of to-day's thinkers. T. G.

The Electrical Age: being Further Everyday Marvels of Science. By V. H. L. Searle. Pp. 229+3 plates. (London: Ernest Benn, Ltd., 1932.) 10*s.* 6*d.* net.

The variety of content of this book will appeal to those who are interested in the application of electrical science to everyday life. Mathematical methods are avoided in order to help the general reader, but the author writes with care for detail as he deals with such diverse subjects as a Sprengel pump, the measurement of time, of high and low temperatures, and the manufacture of gramophone records. The volume provides, in a very readable form, scientific descriptions of many electrical devices, with non-technical statement of underlying principles.

Archaic Tracts round Cambridge. By Alfred Watkins. Pp. 61. (London: Simpkin Marshall, Ltd., 1932.) 3*s.* 6*d.*

Mr. Watkins applies his well-known theory of the sighting relation of prehistoric roads and trackways to mounds, earthworks, churches (as marking older sites), cross-roads, etc., to the Cambridge district. This is the result of a flying visit and most of the work has been done 'on the map'. The author has elaborated a further theory that roads were aligned in reference to cardinal points. The theory is also worked out here for some of his surveys in Herefordshire. Mr. Watkins's work is stimulating, though opinion may differ as to its interpretation.

Practical Physics. By William R. Bower in collaboration with Prof. J. Satterly. Third edition (revised and enlarged). Pp. viii+492. (London: University Tutorial Press, Ltd., 1932.) 7*s.* 6*d.*

That a third edition of this well-known book is called for is clear evidence that it meets a real need in a satisfactory manner, and no one concerned with the teaching or supervision of practical physics will need informing as to its quality. Opportunity has been taken thoroughly to revise the book and bring it into line with modern teaching and examination requirements, increasing its value by the inclusion of new experiments and descriptions of current laboratory practice and apparatus.

Das Vorwort zur Drogenkunde des Bērūnī. Eingeleitet, übersetzt und erlautert von Max Meyerhof. (Quellen und Studien zur Geschichte der Naturwissenschaften und der Medizin, Band 3, Heft 3.) Pp. 52+18. (Berlin: Julius Springer, 1932.) 7.80 gold marks.

This is a very welcome critical translation of the famous "Kitab-i-saidana", referred to for the first time by H. Beveridge in 1902, which exists only in the Persian translation of Abu Bakr. It gives a mass of useful information about certain drugs and chemicals used in the early Middle Ages, and contains precious indications about the corresponding Greek renderings of these substances.

Handbuch der anorganischen Chemie. Herausgegeben von Prof. Dr. R. Abegg, Dr. Fr. Auerbach und Prof. Dr. I. Koppel. In 4 Bänden. Band 4, Abteilung 3, Teil 2B, Lief. 2: *Komplexe Cyanide des Eisens.* Pp. Bxvii–Bxx+B465–B674. (Leipzig: S. Hirzel, 1932.) 24 gold marks.

A detailed account of the complex cyanides of iron, with a bibliography which includes 1,360 references. The frontispiece is a reproduction of early references to Prussian blue by an anonymous writer in 1710, by Woodward and by Brown in the *Philosophical Transactions* of 1724 and by Stahl in 1731.

The Philosophy of a Scientific Man. By Paul R. Heyl. Pp. 182. (New York: The Vanguard Press, 1933.) 1.50 dollars.

This book, which makes delightful reading, could not pretend to contain anything new. It is an act of faith of a scientific man, an act of faith in the purposiveness of the universe and in the power of our reason to apprehend the vague outlines of the reality in which we are embedded. In spite of some hasty generalisations and technical inaccuracies, it should be considered as a valuable testimony at a time when it is still fashionable in certain quarters to disclaim any value for the transcendental concepts of philosophy.

Vox Naturae. By Edwyn Terbea. Pp. 191. (London: Arthur H. Stockwell, Ltd., n.d.) 6*s.* net.

Independent thinkers need every encouragement when they realise the difficulties of the problems of knowledge and conduct, and the relative value of their contributions to their clarification. Mr. Terbea's philosophical outlook will thus appeal to many, in so far as he treats most issues with common-sense and conviction, using as explanatory principles the interfusion of primal, sexual and intellectual urges. T. G.

Progressive Lightning: A New Stereoscope

By Dr. C. V. Boys, F.R.S.

A MOST interesting and illuminating paper on the subject of progressive lightning by Dr. E. C. Halliday[1] describes the results of successful experiments made by himself in South Africa at the instance of Dr. B. F. J. Schonland with an instrument similar to that which I made in the year 1900. As I gave the first description of my instrument in NATURE[2] and have contributed other articles on this subject exclusively to these columns[3] I should be glad to use the same medium for some observations on Dr. Halliday's paper and at the same time describe a new stereoscope designed to examine these photographs without cutting them and also to obtain the physiological advantage of contrast due to reversed stereoscopic effect.

The method of examination of the progress of a lightning flash depends on the use of two images of the flash carried over a photographic plate at a high speed in opposite directions, or of a photographic plate or film carried past two images of the flash in opposite directions. If, then, any part of the flash is subsequent to any other part to an extent visible on the images, these will be distorted in opposite directions and a comparison of the images will give all the information available.

I had the temerity to invent this method of attack in the year 1900 and within a week I had constructed myself an instrument for the purpose. I carried this instrument about, chasing lightning without success, until in the year 1928 I caught up with a flash in America. This photograph, reproduced in NATURE of September 1, 1928, clearly demonstrated that my idea that lightning might occupy some appreciable time while blazing its trail was correct, and Dr. Halliday's photographs confirm this as well as my prediction that an immediately subsequent flash along the same path would be so quick that no aberration would be apparent in the images.

Dr. Halliday's instrument is somewhat less powerful than mine of 1900 but it appears to be ample for the purpose of getting measurable aberration. These instruments are far less powerful than that which Mr. Loomis has at Tuxedo Park, New York, or than the one of similar design which Prof. Adolf Matthias informed me in 1929 that he was going to make. I have not heard whether this instrument ever was made or, if so, whether he has obtained any results. Mr. Loomis and Prof. R. W. Wood have been hunting lightning for two summers with the instrument illustrated diagrammatically in NATURE of July 13, 1929, but so far without success. This perhaps is not surprising, since it was twenty-eight years before I caught a single flash. Thanks to the courtesy of Mr. Goodlet of the Metropolitan-Vickers Electrical Co., Ltd., I was able to test this instrument on their high tension sparks before sending it out to Mr. Loomis. There was never any question of observing progressive development of the 5-ft. spark, but the photographs were so perfect, more especially when Tesla sparks were examined, that the good behaviour of the instrument was assured beforehand. This instrument was constructed by Messrs. Ross, Ltd., at their Clapham works and it is as perfect as such a thing can be. My only fear was that perhaps lightning might be too slow for corresponding pairs of images to be recognisable as being of the same flash.

My method of investigating the progress of a lightning flash has also attracted attention in Western Australia and in Western America, but not apparently in England. I need scarcely say that it has been a source of great satisfaction to me to see Dr. Halliday's paper on his work in South Africa. He sent me an advance draft last autumn but I felt unable to make any reference to it until it had appeared. For this reason I have held back for six months the description herewith of a new stereoscope for observing the progressive character of a flash. That is, unlike any other stereoscope, the instrument indicates time or delay and not solid form.

Coming now to Dr. Halliday's photographs, my object just now is to consider not exactly how his flashes behaved, where they started or how long they took to cover their course, but in the first place to refer to a new point which he has made. It is a little curious that in my American flash, the two images happened to be one above the other and so to be moving horizontally at the time of the flash. Any aberration would result in a bending or a tilting in opposite directions of the two images of the flash, which was nearly vertical. In Dr. Halliday's photographs, on the other hand, the two images happened to be at about the same level and so were moving vertically. According to the aberration that I had contemplated, this would lead to a lengthening of one image and a shortening of the other, and in that case the stereoscope would indicate exactly the same time relief as with the lenses in the other position. Dr. Halliday, however, introduces a new idea. He imagines a flash starting at the cloud and moving downwards. Then he says that the starting point of the flash will remain luminous all the time that is occupied by the flash in travelling to its other end. I suppose he means that electric current would be pouring in at the starting point all this time and keeping it alight. In such case, with the images moving vertically, one image moving towards the cloud's image would, he says, be of its proper length, for the image of the upper end of the flash would be carried towards the cloud exactly to the same extent that the image of the lower end would be carried towards that of the upper end. On the other hand, the other image would be shortened exactly as I have always contemplated. Unfortunately, Dr. Halliday had such wide angle lenses, *F* 2·7, that he had far too much light and his photographs are much spoilt by glare. In my original camera, I used about *F* 8 and with about one-eleventh of the light obtained clear images. I expect *F* 11 or even *F* 16 would give sufficient illumination for the main flash.

Now if my conclusion that the American flash began in the middle is correct, it is difficult to see where the reservoir was to keep up the current. Also, as a matter of fact, the images do not show any broadening at the centre or anywhere. Had current been poured in all the time that the flash was travelling, the image where it started would have been wider than where it finished. According to my view, this lightning flash had some similarity with the flames over a coal fire. Anyone looking at these would believe that the flames were continuous, but if he will look through a moving slit so as to catch a rapid succession of momentary views, he will see that the flame is broken up into a number of elements, and it is the travelling of these upwards in succession that gives the appearance of one long continuous flame. A cinematograph view would be of interest. Similarly, my photograph with images of the same width throughout but slightly different in shape indicates to me that the bright part of the flash travelled from the starting point to the terminal points and that the starting point was not luminous all the time that the flash lasted.

It may well be that no two flashes behave alike and I am not making any point of this difference of view. The real interest to me as an experimentalist is the evidence that the method is capable of ascertaining the facts whatever these facts may be, rather than in worrying over any initial differences in outlook. It seems to me to be far more important to find out what lightning really does than to trouble about ideas of what it ought to do.

It might be worth while to use four lenses equally spaced round a circle so as to obtain for every flash confirmatory evidence of its progress.

The New Stereoscope

Fig. 1 in Nature of September 1, 1928, was obtained by cutting a print in two and rotating each half through a right angle. To ensure this, a straight line had been ruled on the original negative close to and parallel to the line joining the two images, and the two half prints were turned through a right angle until these became vertical. I have found that if I cut up two prints and put two images on each side close together but reversed, that is each the same way up but so that one pair have their sharp edges adjacent while the other have their fading away edges adjacent, the stereoscopic effect of the two pairs is reversed and the contrast makes the effect the more conspicuous.

It is desirable, however, to be able to examine stereoscopically a print without cutting it, and if the contrast due to reversal can be obtained so much the better. This can be done in the following way. Make up a stereoscope by cutting a double convex lens in half and mounting these with their cut diameters away from one another. Then make two isosceles right angle prisms of glass truncated so that the right angle is absent and only the useful part near the hypotheneuse remains. The result is a rectangular prism with inclined ends and the rectangle is best a square. Fig. 1 shows how I have slit an ordinary reflecting prism into three pieces, utilising the two bottom parts. Mount these in two tubes so that they act as reversing mirrors when anything is seen through them. Mount these tubes above the two half lenses at eye distance and arrange that each tube can be turned on its own axis through a right angle, limited at each extremity by screw stops. If now the prisms in these tubes are so placed and moved that all their corresponding edges are always parallel except for the slight convergence, and the square prisms are placed corner-wise so as to turn the images round in the same direction through a right angle as seen by the eyes, these images will then show stereoscopic relief if they are different in form due to aberration. If, then, the tubes are suddenly turned each through a right angle, the images will both be inverted in position and the stereoscopic appearance will be reversed, thus by contrast accentuating the stereoscopic effect. Fig. 2 shows the optical parts only in one position.

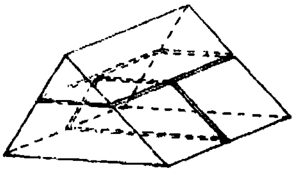

Fig. 1

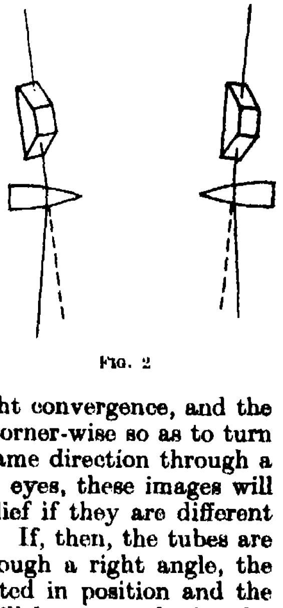

Fig. 2

It may be worth while to say that the shorter the image of a flash is the greater is the stereoscopic impression, because the apparently further and nearer parts, that is, actually the earlier and later, are more closely adjacent on the plate. For this reason it is well to photograph lightning which is not nearer than four or five miles. Short focus lenses also have an advantage in this respect over lenses of longer focus. I did succeed in obtaining with my original instrument quite a spectacular photograph of lightning not a quarter of a mile away and two others on the same plate within a mile. Unfortunately, they are all so much to one side that part of one image of each is off the plate. These were obtained in the night of August 29, 1930, when a terrific thunderstorm of blinding flashes came to St. Marybourne from Winchester, but no flashes were clear of obstruction by rain until they were close up.

Dr. Halliday has made no reference to the stereoscopic method of examination. In his photographs the process of measurement with a micrometer microscope is easy as the aberration is longitudinal. In my photograph where this is transverse, I found measurement with Mr. Loomis's fine micrometer microscope too tedious and the stereoscopic method much more convenient.

I should like in conclusion again to appeal to lightning observers suitably placed to initiate a lightning flash with a rocket. I gave some indication of what to do in my article in NATURE of November 20, 1926, but if anyone should care to consider this more closely, I would recommend the construction of a 'towering rocket' of suitable proportions which should have great persuasive power. Long ago I made a 1 lb. rocket to carry a 6 oz. rocket in its head and this again to carry a 2 oz. rocket which, of course, had the usual stars. The conducting trail which such a combination creates in a very short time and up to an immense height, should initiate a flash almost with certainty if a new flash should be becoming due.

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[1] *Phil. Mag.*, Feb. 1933.

[2] NATURE, **118**, 749, Nov. 20, 1926.

[3] NATURE, **122**, 310, Sept. 1, 1928; **124**, 54, July 13, 1929; and **127**, 425, March 14, 1931.

Researches on Gaseous Combustion*

By PROF. W. A. BONE, F.R.S.

HYDROCARBON COMBUSTION

IN reviewing, in my recent Bakerian lecture, the principal researches upon the combustion of hydrocarbons, the importance was stressed of a balanced judgment embracing the whole range of conditions from slow combustion through flames and explosions right up to detonation. For it is only by taking all conditions into account comprehensively that a true view of the subject can be gained.

It was shown how the hydroxylation theory is capable of expressing the principal facts of both the slow and explosive combustion of gaseous hydrocarbons. For although the conditions prevailing in flames are obviously much more complex than those of slow combustion, the main course of the chemical changes concerned therein may be satisfactorily interpreted on the supposition that the result of the initial encounters between hydrocarbon and oxygen is the same in both, namely, the formation of an 'oxygenated' which (except with acetylene) is a 'hydroxylated' molecule. Undoubtedly, at the higher temperatures of flames, secondary thermal decompositions occur and play a more conspicuous rôle than in slow combustion; but there are the strongest experimental grounds for believing that they do not precede the onslaught of the oxygen upon the hydrocarbon, but arise in consequence thereof. In particular, all the evidence is quite decisive against such views as that of a 'preferential' combustion, whether of hydrogen or carbon, or that in an explosion flame the hydrocarbon molecule is primarily resolved into its elements before being burnt.

Experiments were made showing that the affinities of hydrocarbons so greatly exceed those of either hydrogen or carbonic oxide for oxygen that in explosions of hydrocarbon–hydrogen (or carbonic oxide)–oxygen media deficient in oxygen the hydrocarbon is burnt, as it were, preferentially. Perhaps the most striking experiment of all consisted in exploding a mixture of 25 per cent of acetylene and 75 per cent of electrolytic gas in a stout glass bulb at a pressure of (say) 500 mm. (higher could be used but for the danger of shattering the vessel). A sharp bluish flame filled the vessel, but neither carbon separated nor did any steam condense on cooling, the products consisting of carbonic oxide and hydrogen with traces only of carbonic anhydride or of methane, in accordance with the equation:

$$C_2H_2 + O_2 + 2H_2 = 2CO + 3H_2.$$

A similar result was also obtained on exploding a mixture of equal volumes of ethylene, hydrogen and oxygen, thus:—

$$C_2H_4 + O_2 + H_2 = 2CO + 3H_2.$$

Another most arresting and significant feature of the evidence, also illustrated experimentally, was that whereas all the hydrocarbons of the C_nH_{2n} series, that is, ethylene, propylene, trimethylene and butylene, on explosion with a $C_nH_{2n} + \frac{n}{2}O_2$ proportion of oxygen always yield substantially carbonic oxide and hydrogen only, as though there had been a preferential burning of their carbon, thus:

$$C_nH_{2n} + \tfrac{n}{2}O_2 = nCO + nH_2,$$

explosions of corresponding members of the C_nH_{2n+2} or paraffin series (that is, ethane, propane or butane) with oxygen in the $C_nH_{2n+2} + \frac{n}{2}O_2$ proportion, all result in dense clouds of carbon, steam, methane and oxides of carbon. This striking difference between the behaviours of corresponding paraffins and olefines accords well with the hydroxylation theory.

Moreover, in regard to olefine explosions, another significant fact is that, so soon as the proportion of oxygen in the medium is progressively reduced below the $C_nH_{2n} + \frac{n}{2}O_2$ proportion, steam (as well as carbon) begins to appear in the products and relatively increases in amount as the oxygen content diminishes. This was demonstrated by exploding a $3C_2H_4 + 2O_2$ mixture and it points unmistakably to the initial formation of 'hydroxylated' molecules in such explosions.

In recent years, however, the suggestion has been made that the initial association of hydrocarbon and oxygen molecules in explosions results in a 'peroxidation' rather than a 'hydroxylation', but on closer examination the evidence of such 'peroxidation' has broken down completely. In the first place, whereas in no case of slow combustion of the gaseous hydrocarbons referred to has the postulated initial 'peroxidation' been proved by the isolation of the particular peroxide involved, abundant evidence of the initial formation of alcohols has been forthcoming from experiments on the pressure-oxidation of methane and ethane. Secondly, in the latter case, recent experiments by Dr. D. M. Newitt and Mr. A. M. Bloch in our laboratories have afforded quantitative proof of the hydroxylation theory, no peroxides whatever being found at any stage of the process. Thirdly, in such slow oxidation, the shortest 'induction' and 'reaction' periods are obtained with 2-hydrocarbon-1-oxygen instead of with equimolecular mixtures. Fourthly, experiments upon the induction period have definitely proved that the formation of an aldehyde always *precedes* that of any peroxide, the latter being rarely (if ever) observed. Finally, the 'peroxidation' theory is countered by the results of exploding under pressure methane-oxygen mixtures of compositions intermediate between $5CH_4 + 2O_2$ and $CH_4 + O_2$. Indeed, all the evidence points to any slight peroxide formation which may sometimes be observed during hydrocarbon combustion being a relatively late and minor side occurrence dependent upon a prior formation of aldehyde.

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* Substance of the Bakerian Lecture (*Proc. Roy. Soc.*, A, 137, 243–274) and papers read afterwards at the Royal Society on Nov. 10, 1932 (*ibid.*, A, 137, 57–88).

EXPLOSIONS AT HIGH PRESSURES

In continuance of researches upon gaseous explosions at high initial pressures carried out for many years past by Drs. D. M. Newitt, D. T. A. Townend and myself at the Imperial College, we have recently published further results of experiments upon (1) hydrogen–air and carbonic oxide–air explosions at initial pressures between 250 and 1,000 atmospheres, and (2) the formation of nitric oxide in carbonic oxide–oxygen–nitrogen flames and explosions.

The previous work had resulted (*inter alia*) in the discovery of a nitrogen activation in $CO–O_2–N_2$ explosions at high initial pressures, due to an absorption by nitrogen molecules of the radiation emitted by the burning carbonic oxide, the effect steadily increasing with the density of the medium but apparently approaching a maximum at initial pressures of about 150 atmospheres, although its intensity relative to the total kinetic energy developed had been greatest at $P_1 = 75–100$ atmospheres. The new experiments were designed to show not only (*a*) how much further the effect would increase with the density of the medium, but also, (*b*) in presence of excess of oxygen, how much of the nitrogen thus activated would form nitric oxide during the explosions, the latter consideration being of importance from the point of view of a possible commercial process for the direct fixation of nitrogen.

In investigating (*a*), a special super-pressure bomb, with a cylindrical explosion chamber 3 in. long and 1½ in. in diameter (capacity 115 c.c.), capable of withstanding explosion pressures up to 10,000 atmospheres (with a safety factor of 4), was employed; and the pressures actually developed far exceeded any yet recorded in any explosion experiments. For determining (*b*), a $2CO + 3O_2 + 2N_2$ mixture, which is the most favourable of all to the formation of nitric oxide, was exploded at various initial pressures between 40 and 88 atmospheres in a nickel-steel bomb (explosion chamber = 990 c.c.) in such-wise that at some predetermined moment during the explosion a steel disc partition was burst suddenly, liberating the gaseous products into a large 'expansion chamber' (capacity = 38 litres) from which they were afterwards withdrawn for analysis.

Theoretical hydrogen–air (that is, $2H_2+O_2+3{\cdot}76N_2$) explosions went off quite normally up to an initial pressure (P_1) of 500 atmospheres, the 'explosion time', t_m, being of the order 0·015–0·022 sec., but tending to increase with the pressure. The subsequent rate of cooling accorded with Newton's law throughout, being uncomplicated by any appreciable exothermic effect; the amount of steam-dissociation at the maximum explosion temperature (T_m) was always less than 0·5 per cent. At $P_1 = 750$ atmospheres, however, such violent detonation was instantaneously set up that the screw threads of the bomb fittings were seriously damaged and it was deemed too dangerous to proceed to any higher pressure.

Explosions of theoretical carbon monoxide–air (that is, $2CO + O_2 + 3{\cdot}76N_2$) mixtures were successfully carried out at various initial pressures up to and including 1,000 atmospheres, with results showing that the nitrogen activation had reached a maximum at $P_1 = 350$ atmospheres, when its exothermic effect on the cooling curve was equivalent to some 12·5 per cent of the total kinetic energy developed. In explosions at $P_1 = 1{,}000$ atmospheres, $t_m = 0{\cdot}24$ sec., and the maximum gauge pressure (P_m) developed was 7,100 atmospheres (about 46 tons per sq. in.), with T_m just under 3000° K. The percentage dissociation of carbon dioxide at T_m ranged from 2·4 at $P_1 = 250$ up to 5·5 with $P_1 = 1{,}000$ atmospheres.

The $2CO + 3O_2 + 2N_2$ explosions (*b*) showed not only the beneficial influence of pressure upon the nitric oxide formation, but also that in all cases it begins during the 'combustion period' and extends far into the 'cooling period'. Thus, whereas at $P_1 = 70$ atmospheres only about 3·3 per cent of nitric oxide had been formed up to the moment of maximum pressure ($T_m = 2900°$ K.) as much as 5·4 per cent was present some 0·06 sec. thereafter; and at $P_1 = 88$ atmospheres the maximum nitric oxide formation would be of the order of 6 per cent. Such yields of nitric oxide are many times higher than any previously obtained in explosions.

Obituary

Prof. G. C. Bourne, F.R.S.

The death on March 8 of Gilbert Charles Bourne, emeritus professor of zoology and comparative anatomy in the University of Oxford, will be deplored by his colleagues and many friends in Oxford and elsewhere. The sudden ending of such a remarkably active and useful life will be felt as a serious loss.

Since 1919 and up to his last illness, Prof. Bourne had, with characteristic energy, taken a prominent part on the Advisory Committee on Fishery Research to the Development Commission of which he eventually became chairman, succeeding Sir William Hardy in 1931. The success of the Freshwater Sub-Committee, of which he was also chairman, owed much to his untiring labours, his wide knowledge of biology and his business ability. No less valuable were his services to the Water Pollution Research Board of the Department of Scientific and Industrial Research. Under his chairmanship of committees a thorough biological, chemical, and hydrographical survey of the River Tees was carried out and similar work undertaken on the Mersey.

Of a friendly, sanguine, and generous disposition, and actuated by a strong sense of public duty, Bourne was always ready to serve his country in peace or war. As a young man, he joined the Volunteers and the militia in which he rose to the rank of Lieutenant-Colonel (Hon. Colonel). During the War he was chiefly engaged in the training of recruits.

Bourne's fame as an oarsman and a rowing coach is known to all. His versatility was indeed remarkable. There were few practical things he could not do and do well. He seemed equally proficient with the oar or the marine trawl, the microscope or the sporting gun.

Born in 1861, the son of Lieut.-Col. Robert Bourne, of Cowarne Court, Herefordshire, he was educated at Eton and New College, Oxford. Always interested in natural history, he studied zoology under Prof. H. N. Moseley, worked for a short time with Prof. Weismann in Freiburg, and, after taking his degree, started on his scientific career. A description of the anatomy of the millipede, *Sphærotherium*, more especially of its stridulating organ, read before the Linnean Society in 1885, was his first publication.

In the same year Bourne visited Diego Garcia, that lonely tropical island set in the midst of the Indian Ocean. Here he studied corals, having joined that band of enthusiasts, including A. C. Haddon, S. J. Hickson, and G. H. Fowler, who did so much to advance knowledge of these and other cœlenterates. Diego Garcia is a typical coral atoll, and Bourne was among the first to treat atoll-formation not so much as a problem of geology as one to be attacked from the point of view of biology. His observations made on the spot of the conditions under which corals live and grow, flourish and decay, enabled him to contribute an important paper to the *Proceedings of the Royal Society* in 1888. Meanwhile, on his return, he had begun a series of papers on the structure and growth of various corals, of which those on *Fungia* (*Quart. J. Micro. Sci.*, 1887) and on *Heliopora* (*Phil. Trans.*, 1896) are perhaps the most outstanding. He was also interested in the Crustacea, wrote on *Monstrilla* and other copepods; and later made an elaborate study of crabs of the family Raninidæ, for which he founded the new tribe Gymnopleura (*J. Linn. Soc.*, 1922).

The translation of Pelseneer's masterly volume on the Mollusca for the "Treatise on Zoology", undertaken at Sir Ray Lankester's suggestion, turned Bourne's attention to new fields, and led to the appearance of several works on little-known molluscs, particularly on the Neritacea and other gastropods (*Proc. Zool. Soc.*, 1909, 1911). These various contributions on the structure and classification of the Invertebrata are all distinguished for care and thoroughness, and for the excellence of the illustrations; for he was a patient and skilful dissector and a very accurate draughtsman. Together they form a solid and lasting addition to zoological science.

Bourne's more general works include "An Introduction to the Study of the Comparative Anatomy of Animals", one of the best elementary textbooks of the kind when it first appeared in 1900, and still a useful and trustworthy guide for the student. To Lankester's well-known "Treatise on Zoology" he contributed comprehensive parts on the Ctenophora and on the Anthozoa, including, of course, his beloved corals.

Soon after taking his degree, Bourne was elected fellow of New College, and later became tutor as well. For a couple of years he went to Plymouth as director of the recently established Marine Biological Laboratory. On his return to Oxford he taught for many years in the Department of Zoology and Comparative Anatomy. In 1906 he succeeded Prof. Weldon in the Linacre chair, which he occupied with distinction until his resignation in 1921. He was elected to the fellowship of the Royal Society in 1910, and was president of Section D (Zoology) of the British Association at Sheffield in the same year.

Bourne married the daughter of Sir John Croft, Bt., who survives him with one son and one daughter. The former, Capt. R. Bourne, is now member of Parliament for Oxford. E. S. G.

We regret to announce the following deaths:

Sir John Jackson, O.B.E., deputy chief inspector of factories from 1920 until 1930, on March 19, aged sixty-eight years.

Dr. Thomas C. Porter, for many years science master at Eton College and one of the founders of the (Public Schools) Science Masters' Association, on March 31, aged seventy-three years.

News and Views

Nature of the Nerve Impulse

THE intimate nature of the nervous impulse has long been a subject for speculation by physiologists and psychologists. Simple models to explain the mode of transmission of an impulse along a nerve, like the electrical one of the marine telegraphic cable or like the chemical one of a train of gun-powder, have proved to be totally inadequate to explain the various phenomena observed in nerve. Until recently, the relative unfatiguability of nerve favoured a simple physical and non-chemical hypothesis. Modern refinements in technique, however, have shown that nerve during activity utilises chemical energy and produces heat. It is only in the last few years that the two phases of heat production in nerve have been analysed, and an account from the leading investigator in this field, Prof. A. V. Hill, appears in the special supplement to this week's issue of NATURE. Prof. Hill favours an electrochemical theory of a self-propagating wave of disturbance to explain the various forms of behaviour exhibited by an impulse in its passage along a nerve. Interesting experiments on the ionic distribution of potassium ions lend convincing support to the theory. The supplement will also be found to give a useful summing-up of the present position reached by investigators in this branch of nerve physiology.

Sir Charles Peers, C.B.E.

SIR CHARLES PEERS, Chief Inspector of Ancient Monuments and president of the Society of Antiquaries, has been awarded the Royal gold medal of the Royal Institute of British Architects for his services to architecture. The presentation took place at the Institute on April 3. Sir Charles Peers has now held office as Chief Inspector of Ancient Monuments for twenty years. It is largely owing to his zeal in carrying out his duties and the breadth of his practical knowledge in archæological matters that, not only have a large number of our antiquities been preserved from vandalism, but also the co-operation of the Office of Works, of which he is an officer, has been sought readily and with confidence by those who are interested either as owners, as archæologists, or as members of the public in the future as well as the past of ancient monuments. At the same time, the powers and duties of his office and his department, which were anything but adequate at the time of his appointment, have been enlarged by successive Acts of Parliament, until, with notable reservations to which attention has been directed with emphasis recently, such monuments are now within a measurable distance of a reasonable assurance of safety.

Trevithick Centenary Exhibition

IN connexion with the celebration of the centenary of the death of the great Cornish engineer and inventor Richard Trevithick, the 'father' of the steam locomotive, a memorial exhibition has been arranged in the main gallery of the Science Museum, South Kensington. Trevithick was an inventor of astonishing fertility but his main contribution to engineering progress was his invention of the high-pressure non-condensing steam engine and its application to both road and rail locomotives. His outstanding patent was taken out in 1802, and engines were made all over England to his designs. Of these engines two excellent specimens are shown, one with a cast iron boiler, made in 1805, and another made in 1811 with a wrought iron boiler. Unfortunately, nothing remains of his several locomotives, but various documents and drawings are exhibited and there are also some of the cast iron rails from Penydarran, South Wales, on which his first locomotive ran. This engine, the first rail locomotive in the world, is known to have drawn five wagons with a load of ten tons in 1804, and four years later Trevithick exhibited a locomotive, afterwards named *Catch-me-who-can*, "in the fields adjoining the Bedford Nursery near Tottenham Court Road", London. The next locomotive of importance was that constructed by Matthew Murray for John Blenkinsop at Leeds in 1811, but the original drawings for this were supplied by Trevithick, who received a royalty on the engine. The exhibition also includes Linnell's portrait of Trevithick painted in 1816, Burnard's bust and many interesting letters and documents.

Memorial to Thomas Tompion

ON Saturday, April 1, a plaque in memory of Thomas Tompion, the clockmaker, was unveiled in St. Mary's Church, Northill, Bedfordshire, where he was born in 1639, and simultaneously a wreath was laid on his tomb in Westminster Abbey, where he was buried in 1713. The plaque is the gift of the Clockmakers' Company and was unveiled by the Master, Mr. B. Kettle, the address at the service being delivered by the Archdeacon of St. Albans, the Ven. A. H. Parnell. At the ceremony at the Abbey, Sir Francis Newbolt, the Deputy Master of the Clockmakers' Company, said Tompion was honoured by the Company as one of its greatest Masters. So great was his mechanical genius and incessant industry that he was appointed clockmaker to the Royal Observatory at Greenwich at its foundation. He was a brilliant craftsman and made practical the theoretical inventions of others. He left English watches and clocks the finest in the world and the admiration of his brother artists. The grave Tompion lies in, it may be remarked, also contains the remains of his famous pupil and successor, George Graham, who died in 1751. The slab now to be seen in the Abbey, on which Graham's remarkable skill is referred to, was removed in 1838 and a small lozenge-shaped stone substituted. Thanks, however, to Dean Stanley, the original was replaced in 1866.

Centenary of Maurice Loewy

ON April 15 occurs the centenary of the birth of the distinguished astronomer, Maurice Loewy, who, from 1896 until 1907, held the directorship of the

Paris Observatory, a post to which he was appointed on the death of Felix Tisserand. Born in Vienna in 1833 of Jewish parents, Loewy passed through the Polytechnic School and University of Vienna and then entered the old Imperial Observatory of the capital, where he was trained by Karl Littrow. Being invited to France by Le Verrier, he became a naturalised Frenchman and in 1864 joined the staff of the Paris Observatory, serving under Le Verrier, Delaunay, Mouchez and Tisserand. He took an active part in the completion of the great Paris Catalogue of Stars and in the inauguration of the International Star Chart. So early as 1871 he proposed to Delaunay the new form of telescope since known as the equatorial *coudé*, but it was not until 1882 that the first instrument of this kind was erected, the cost of the telescope then being defrayed by the generous banker Raphael Bischoffsheim (1823–1906), the founder of the Nice Observatory. A description of the instrument appeared in NATURE of November 8, 1883, p. 36. For thirty years Loewy was director of the *Connaissance des Temps*, and from 1872 was a member of the Bureau des Longitudes, taking part with Mouchez in the inauguration of the observatory in the Parc de Montsouris for the instruction of navigators and explorers. From 1873 onwards he was also a member of the Academy of Sciences. He received many honours from learned societies and in 1889 was awarded the gold medal of the Royal Astronomical Society. He died suddenly on October 15, 1907, at the age of seventy-four years, when addressing a meeting of the Conseil des Observatoires astronomiques.

Priestley Bicentenary Celebrations at Warrington

WHEN non-conformists were debarred from studying at Oxford and Cambridge, a number of dissenting colleges came into existence, among the most famous and successful of which was the Warrington Academy, through which, during its existence from 1757 until 1783, some four hundred pupils passed. It was in this Academy that Priestley taught from 1762 until 1767, and it was there he wrote his "History of Electricity". In 1898 the Warrington Society was formed with the object of preserving the building which originally housed the Academy, and to-day it possesses an interesting collection of Priestley pictures, books and medallions. In conjunction with the Warrington Philomathic Society, therefore, it held a Priestley commemoration meeting in The Old Academy on March 17, when the Priestley relics were shown to visitors and two addresses were given, the first being by Mr. J. Hawthorn on "Joseph Priestley and Warrington" and the second by J. S. Broome on "Priestley's Scientific Work in Warrington". When Priestley was offered a post at the Academy, he followed Dr. Taylor as tutor in languages although, as he himself wrote, "I should have preferred the office of teaching the mathematics and natural philosophy, for which, I had at that time a great predilection". In spite, however, of being employed five hours a day in lecturing on English, Latin, Hebrew and other subjects, he yet found time to make experiments and carry on a correspondence with Franklin, and it was his scientific work at Warrington which led to his being admitted to the fellowship of the Royal Society.

Stereochemistry and Physics

THE Faraday lecture of the Chemical Society was delivered at the Royal Institution on March 29 by Prof. Peter Debye, of the University of Leipzig. He took as his subject "The Relations between Stereochemistry and Physics" and gave a brilliant exposition of certain methods used for the elucidation of molecular shape and dimensions, methods to which his own contributions, both in theory and in experimental technique, have been all-important. Until comparatively recently, the two factors which essentially determine the dielectric constant of a substance were not clearly distinguished from one another. Prof. Debye showed how the total polarisation in an electric field is compounded of the natural polarisation inherent in the molecules themselves and of an induced polarisation, due to their electrical deformability; how the relative contributions of these two effects can be estimated by investigating the influence of temperature on dielectric constant; and how the magnitude of the natural dipole moment thus obtained can give valuable information on the degree and the nature of symmetry of the molecule. Examples were quoted from the work of Errera, Smyth and Williams.

IN the latter half of the lecture, Prof. Debye dealt with his pioneer investigations on X-ray interference patterns produced by isolated molecules, describing the technique, the application of the numerous necessary corrections to the experimental data, and the interpretation of the latter in terms of the interatomic distances in the molecule. Mention was made of the related electron ray method of Mark and Wierl. He illustrated his fascinating topic by reference to work on the chlorine substitution products of methane, and to the problem of free rotation of single bonds. The interest and enjoyment of his hearers were obvious. One may indeed be excused for thinking that very seldom are occasion and lecturer, theme and audience so completely attuned to one another as happened at this lecture. Prof. Debye had no difficulty in establishing Faraday as a pioneer of ideas in the fields both of the electrical properties of molecules and of the spatial arrangement of atoms within them. All felt that Sir William Bragg was right when he claimed that Prof. Debye and Faraday were akin in spirit; Prof. Donnan was equally right when he termed Prof. Debye the friend of the chemist, of the "hydrophobic organic chemist equally with the hydrophilic physical chemist".

The Chemical Society

PROF. G. G. HENDERSON, the retiring president of the Chemical Society, devoted his presidential address on March 30 to an examination of the present position and the future of the Society. Scientific societies, he said, must be ready to modify their policies in accordance with changing conditions. The work of the Chemical Society in pursuing the objects for which it was founded has increased during the past year, and the work of the Bureau of Chemical Abstracts also reflects the ever-increasing amount of investigation which is being performed in the chemical field. New decisions which will help to meet modern needs include devoting a larger number of meetings to organised discussions and summaries of recent work, offering fellowship to young chemists at half the annual subscription, selecting the papers to be read at ordinary scientific meetings, arranging that some of the endowed and special lectures shall be delivered elsewhere than in London, and appointing local representatives who will arrange lectures or discussions in collaboration with the local secretaries of other chemical organisations, and will generally promote the interests of the Society. The Council does not contemplate the establishment of local sections of the Society, since numerous local sections of the Institute of Chemistry, the Society of Chemical Industry, and of other societies are already in existence.

Federation of Chemical Societies

PROF. HENDERSON also referred to the new format of the *Journal* of the Society, and remarked : "I trust that the combined effort of the Chemical Society and the Faraday Society to produce a joint publication, which is destined to be the representative journal of British physical chemistry, will be brought to a successful issue, and that the new journal will appear next year". New conditions have created new wants, and he feels that new methods with respect to administration, to the representation of fellows in the Council, to the production and distribution of publications, and to the association of the Society with other chemical organisations must be adopted. Federation or union of at least all the principal organisations concerned with chemistry, said Prof. Henderson, is a project which is making an appeal to an increasing number of members of the profession. Prof. Henderson referred to an article on the subject in NATURE of September 24, 1932, and quoted the conclusions, saying that they well summarise the facts which compel attention to this matter. "So long as the Society remains, as now, an independent organisation," he said, "I cannot see how a larger income is to be obtained . . . and every method of reducing expenditure which can be adopted under existing conditions has been closely investigated. The same statement applies generally to the Society of Chemical Industry, the Biochemical Society, the Faraday Society, and other societies more directly interested in various branches of applied chemistry, which publish journals or abstracts or both. Consequently one is forced to the conclusion that some form of federation of these societies is not only desirable, but sooner or later inevitable. Moreover in my opinion such a federation would be incomplete and lacking in influence unless the professional organisations were also included as members."

THE kind of federation which Prof. Henderson envisages would not involve material loss of individuality on the part of the members of the separate societies, for each has its special sphere of activity on behalf of the subject as a whole and of the profession generally. The final decision must rest with the members of the organisations concerned, but Prof. Henderson said he is confident that if chemists of all kinds got together in some such way as he had indicated, the effect would be altogether beneficial to the profession. He believes that the movement, if generally supported, would be welcomed by the chemical industry of the country. Sympathetic consideration must be given to the scheme to be put forward by the Federal Council for Chemistry, which has appointed a committee to frame proposals calculated to afford the chemical societies of Great Britain means of securing economies, increased efficiency, and mutual advantage.

Houston Expedition over Everest

THE Houston Air Expedition to Mount Everest succeeded in its object to fly over the actual peak on the morning of April 3. The flight, starting from Lalbalu aerodrome, occupied three hours, flew about 160 miles including two circuits of the peak, reached more than 31,000 ft. altitude, and actually cleared the top by only 100 ft. The two machines, a Houston-Westland and a Westland-Wallace (Bristol Pegasus S.III engines), flew in company and carried out a concerted programme of duties. The decision to make the flight was taken on the advice of the Indian Government Meteorological Station at Purnea, which reported winds of 57 m.p.h. velocity, without undue bumpiness, at 33,000 ft. altitude, by means of the usual balloon observations. Air-Commodore Fellowes, the leader, made a preliminary reconnaissance in his Puss Moth machine before making the final decision to start.

CONSIDERABLE credit is due to the crews of the Houston Expedition for their navigation, as it was impossible to adhere to the prepared scheme of observations from landmarks owing to a heavy dust haze extending up to 19,000 ft. They also met with severe down currents due to the deflection of the west wind over the mountain, causing a loss of altitude of more than 1,500 ft. in a few seconds in one case. Very good still photographs were obtained, but the results of the cinema cameras are not yet known. The automatic survey cameras were not working during part of the flight, which may mean that necessary connecting parts of the mosaic survey may be missing. In this event a further flight will be made if permission can be obtained from Nepal. The unusual clearness of the air made it difficult for the photographers to judge distances accurately. The crews were afterwards examined by the expedition's doctor, who found that they were tired, but not unduly exhausted. On April 4, a further flight was made by both machines over Kanchenjunga.

Loss of the *Akron*

WE much regret to record the total loss of the United States naval airship *Akron*, which occurred on April 4. It appears that the vessel left Lakehurst for a cruise over the coast of New England on April 3 in order to test her wireless compasses. A wireless message during the evening reported that all was well and nothing further was heard until a German tanker, the *Phœbus*, reported by wireless that the *Akron* had 'crushed' at sea and that four of the crew had been picked up, one of whom died later. One of the survivors is Lieut.-Comdr. H. Wiley, the second-in-command, who has recovered sufficiently to make a report on the disaster. The airship sighted a thunderstorm at 8.45 p.m.; later, the ship at 1,600 ft. appeared to be surrounded by lightning and about midnight she began to descend rapidly. Ballast was thrown out and she regained altitude, only to descend again a few minutes later. The rudder control was carried away as the airship crashed and it seems that the main part of the ship sunk almost immediately. The *Akron* was the largest airship in the world, her gasbags were filled with helium, and, at the time of the disaster, there were seventy-seven officers and men aboard, including Rear-Admiral William Moffett, chief of the U.S. Naval Bureau of Aeronautics. Rescue work was hampered by the weather, and a 'blimp' returning from a search for survivors was blown into the sea on attempting to land, one of the crew being drowned and the commander dying shortly afterwards. Yet another airship accident has been reported, this time from France, where the semi-rigid naval dirigible E9, crashed near Guerande on April 4, two of the crew of twelve being injured.

Science at the Ideal Home Exhibition

THE *Daily Mail* Ideal Home exhibition at Olympia, which was opened by Mrs. Stanley Baldwin on March 29 and will remain open until April 29, is, as usual, a remarkable tribute to the influence science now exerts on the equipment of up-to-date houses. Thanks to the use of gas and electricity, the investigations of the chemist, physicist and metallurgist, the duties of every housewife are steadily being lightened and the comfort and convenience of everyone increased. The gradual improvement in the quality of food and in its preparation, and in all connected with lighting, heating and ventilation is indeed remarkable. New metals, new materials and new designs, and the application of scientific methods are seen on every hand. The exhibition occupies the Grand Hall, the National Hall and the Empire Hall, and in the first of these is an admirable and beautiful scheme of decoration which includes, as its outstanding feature, a portion of an immense rainbow composed of no less than 700 ft. of neon tubes, fitted up by Messrs. Venreco, Ltd.

WITHOUT attempting to refer to the many exhibits which owe so much to scientific research, attention may be directed to the interesting series of "Rooms of the Scientists" in the gallery of the Empire Hall, where "for the first time in history, are gathered together a collection of exhibits more romantic than any story, more sensational in their results than the wildest fiction". There are nine of these rooms showing respectively Archimedes in his villa at Syracuse; Roger Bacon in prison; Newton in his study at Cambridge making his experiment on light; a part of the surgical ward at the Glasgow Royal Infirmary where Lister did his important work during 1861–69; the tent of Sir Ronald Ross in which he made his observations on the relation of the mosquito to malaria; Darwin's study at Down House in which he wrote "The Origin of Species"; a replica of Prof. Piccard's sphere in which he made his record ascent into the air; Faraday's laboratory at the Royal Institution; and lastly, the wireless cabin of the Marchese Marconi on his yacht *Elettra*. The tableaux are admirably arranged and the eminent men of science are represented by members of the theatrical profession, that of Newton, for example, being played by Mr. Rodney Barrie. The whole exhibit has been staged by Prof. A. M. Low for *Armchair Science*, with the assistance of many scientific bodies and individuals, including the British Museum, the Science Museum and the Royal Institution.

Bequests for Geological Research

MR. BERNARD HOBSON, of Sheffield, who died on December 3, left estate of the net value of £142,125. He bequeathed £1,000 to the Yorkshire Geological Society, Leeds; £1,000 to the Geological Society of London, to be called the "Bernard Hobson Fund", the annual income of which is to be used in buying British, Colonial and foreign geological maps, to be placed on linen conveniently folded for the pocket for use of the members of the Society; and £1,000 to the British Association for the Advancement of Science, to be called the "Bernard Hobson Fund", the annual income of which is to be devoted to promoting definite geological research. After making further bequests totalling about £3,000, Mr. Hobson left the residue of his estate to his brother and sister for life, with remainder to the University of Sheffield. Mr. Hobson had been a member of the Council of the University for some years. He belonged to a family which had taken a special interest in it. His father, Mr. John Hobson, was a member of the Council of Firth College, from which the University sprang. His brother, the late Sir Albert Hobson, as Master Cutler in 1903, took a leading part in the movement for the establishment of the University, and served successively as Treasurer of the University and Pro-Chancellor. Sir Albert, who died in 1923, also left the residue of his estate to the University.

Research Grant for the Cancer Hospital (Free), London

RECENTLY the investigations on the chemical aspects of the cancer problem which are in progress at the Research Institute of The Cancer Hospital (Free), Fulham Road, London, have received recognition and financial assistance from two sources. The trustees of the Halley Stewart Trust have made a grant for a period of three years to support a whole-time worker who will undertake biochemical investigations into the metabolism of cancerous growths. Dr. C. A. Mawson of the Victoria University of Manchester has been appointed to carry out this work.

(*Continued on p. 509*)

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The Physical Nature of the Nerve Impulse*

By PROF. A. V. HILL, O.B.E., F.R.S.

ALL our sensations, all our movements, most of the activities of our nervous system, depend upon a certain transmitted disturbance which we call the nervous impulse: this, in the study of nerve activity, is what the atom, the electron and the quantum are to chemistry and physics. A rapid reaction to events occurring at a distance is necessary for efficient working. Special nerve cells, therefore, have been developed in all the larger animals: from these the axon or nerve fibre runs out, which is only 3 μ to 25 μ in diameter but may be many metres in length. Along these fibres wave-like messages are sent.

The velocity of a nerve impulse varies greatly according to the fibre in which it runs and to the conditions affecting the fibre. In the medullated nerve of a mammal the velocity is of the order of 100 metres per second. (Compare this with 330 metres per second, the velocity of sound.) In the medullated nerve of the frog at 20° C. it is about 30 metres per second. In the non-medullated nerve of a mammal it is said to be about one metre per second; in the non-medullated nerve of the pike and of *Anodon* respectively it is stated to be 0·2 metre and 0·05 metre per second. The velocities in this list are in the ratio of 2,000 to 1.

The nerve impulse is an event, a wave, a propagated disturbance, not a substance or a form of energy. It is transmitted along a thread of protoplasm which, in medullated nerve, is surrounded by a protecting or 'insulating' sheath. Its passage can be detected in several ways: (*a*) by its physiological effect on the organ to which it runs, (*b*) by the electric change which accompanies its transmission, (*c*) by a production of heat, and (*d*) by a consumption of oxygen and a liberation of carbon dioxide.

No difference of electrical potential can be detected in an uninjured resting nerve. If, however, the nerve be injured, for example, by cutting, a potential difference is found of the order of a few hundredths of a volt between the injured and the uninjured parts, in the sense that positive current runs in an external circuit towards the former. The injury does not *produce* the potential difference; it merely allows its normal presence across the fibre boundary to be manifested.

If two electrodes be placed on a nerve and the nerve be stimulated, a momentary change of potential travels along it which can be recorded with an oscillograph. At any given instant a certain length of the nerve of the order of a few centimetres is found to be the site of a wave of negative potential. We are probably right in thinking that the impulse itself, whatever that be, occupies the same region and moves at the same speed as its electrical accompaniment.

PROPERTIES OF THE NERVE IMPULSE

Let us consider the properties of the impulse which is transmitted, or transmits itself, in nerve. The single impulse in the single fibre is the basis of nerve activity. Until recently, this individual impulse could not be separately examined and deductions had to be made from the results of stimulating many fibres in parallel. Of late, however, through improvements in electrical recording, it has become possible to register the form and movement of the electric change resulting from a single impulse in a single fibre.

(*A*) A single impulse has an 'all-or-none' character. Its size cannot be varied by changing the strength of the stimulus which produces it: it makes no difference to the magnitude of the discharge how hard the trigger is pulled. (*B*) An absolute 'refractory' period follows the passage of an impulse, a period during which no stimulus, however strong, can evoke a second response. In frog's nerve at 20° C. this absolute refractory period is about 0·001 sec. (*C*) As a consequence of (*B*), two nerve impulses going in opposite directions in the same fibre come each into the refractory region of the other and both are abolished. 'One way traffic' alone is possible: separate sensory and motor systems are required. (*D*) After the absolutely refractory stage a relatively refractory stage persists, during which a stronger stimulus than usual is required to start an impulse, and the second impulse, measured by electric change or heat, is smaller than the first one. Discharge can take place before recharge is complete. (*E*) As a result of the refractory phase, the frequency of transmission is limited. Prof. H. S. Gasser of New York recently informed me that he had made mammalian nerve carry 1,500 impulses per second, and that at 1,000 per sec., impulses were not greatly subnormal. In the normal functioning of the nervous system nearly all messages consist of trains of impulses of varying frequency. (*F*) The impulse at any instant occupies a few centimetres of the fibre. This length is not much altered by a change of temperature and it is approximately proportional to the diameter of the fibre. There must be some simple physical reason for these facts, as also for the next one. (*G*) The velocity of the impulse is also approximately proportional to the diameter of the fibre. Consequently in a given nerve trunk which consists of fibres of various diameters, a wave started electrically at one end gradually spreads out and appears as a series of waves corresponding to the several maxima in a frequency curve. (*H*) When the temperature is raised or lowered by 10° C. the velocity of transmission is increased or diminished in the ratio of 1·7 to 1. (*I*) The passage of an impulse is associated with a liberation of heat to which some special attention is necessary.

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* Friday evening discourse delivered at the Royal Institution on Feb. 10.

HEAT PRODUCTION OF NERVE

No work is performed, no force is developed, no movement at all occurs in a nerve when it is active, and for long it was believed that in the transmission of nerve impulses no heat is evolved. Many attempts were made to measure the heat, all unsuccessful until 1925. To-day, when the heat production of nerve can be measured almost as well as that of muscle could in 1920, it is hard to believe that for many years we argued as though there was no heat at all associated with nerve activity. It is true that the amount is small, that the *total* heat (which takes thirty to fifty minutes to appear) in a single impulse in a gram of nerve is only about one millionth of a calorie, and it is true still that we must have several impulses before we can measure the heat properly, but with that provision and with present-day arrangements, the measurement is comparatively simple and accurate. The sensitivity is such (i) that a galvanometer deflection of 1 mm. (readable to 0·1 mm.) corresponds to a rise of temperature of about three millionths of a degree, and (ii) that during a steady state of heat production one millimetre of steady deflection corresponds to a rate of heat production of about 2×10^{-8} calorie per second.

The heat is produced not only during the passage of the impulse *but for a long time afterwards;* some kind of breakdown occurs, presumably as the wave goes by. This breakdown has then to be reversed, the nerve allowed to recover, in a re-charging process of some kind which takes place afterwards. The fact that heat is produced, and the manner of its production, dispose of the possibility that the nerve impulse is, to use Bayliss's words, a "reversible physico-chemical process".

At 20° C. the initial heat in a single isolated impulse in a frog's medullated nerve lies between 10^{-7} calorie and 3×10^{-6} calorie per gram of nerve. The recovery heat, which continues for a long time after the impulse has passed, is about ten to thirty times as much. During continual stimulation, say of fifty shocks per second, a steady state is gradually reached in which recovery balances breakdown, the recovery heat in any given interval representing the process of restoration from all the impulses which passed in the preceding forty minutes. During the steady state, which is possible only in oxygen, the total heat production may occur at the rate of about 25 microcalories per gram per second. At a higher frequency the total heat rate may, for a time, be rather greater, but a genuine steady state is not possible; fatigue progressively sets in. It is striking that the *resting* rate of heat production of the same nerve is about 70×10^{-6} calorie per gram of nerve per second, so that moderate activity only increases the metabolism of a nerve by a comparatively small amount, even extreme activity does not double it. The mere maintenance of the machine in working order requires more energy than the excess required when it goes full speed during activity.

This initial heat is the result presumably of some chemical reaction involved in, or immediately after, the transmission of the impulse. If we suppose the reaction to occur throughout the substance of the axis cylinder, its heat is so small that it is difficult to picture any mechanism by which the change could be propagated. There are other grounds—for example, the relation between speed and diameter—for supposing that the reaction, whatever it be, is somehow connected with the surface of the fibres. It can be calculated that the area of the surface in a gram of nerve is of the order of 2,000 sq. cm., and that the energy in the transmission of a single effective impulse is from 5×10^{-3} to $2 \cdot 5 \times 10^{-4}$ erg per sq. cm. of fibre surface. This is still a very small quantity, the smallness of which can be realised by the statement that it is 1/4,000 to 1/80,000 of the surface energy of a water–olive oil interface.

One naturally asks, may not the initial heat be really due to the electrical disturbance transmitted in nerve? If we take the observed potential differences along the nerve and assume that these cause currents to flow through the conducting media inside and outside the sheath, then the Joule's heat of the currents can be calculated. The result is only a small fraction, less than one per cent, of the observed initial heat. There is another possibility, however, namely, that the nerve is to be regarded as a charged electrical condenser which is discharged as the wave passes by. The energy of a condenser of capacity F microfarads, charged to V volts, is $5FV^2$ ergs. Taking V as 0·05 we should require a capacity of the order of half a microfarad per square centimetre of nerve fibre surface to give us the observed initial heat. There is some evidence that capacities of this size may possibly exist at the surface of living cells. If so, we should not need to look for a chemical reaction to explain the initial heat—

the electrical discharge would be sufficient. Other evidence, however, makes it unlikely that this is really the source of the heat.

The recovery process by which the nerve is restored to its initial condition is of an oxidative nature, though deprival of oxygen does not immediately cause it to fail. Apparently the nerve possesses, maybe as a safeguard against asphyxiation, a store of oxygen in some form other than molecular. A nerve may go on functioning and carrying out its usual recovery for hours, or even days (depending on the temperature) before all its oxygen store is used up. Then, and only then, it fails. If a nerve asphyxiated by lack of oxygen is given oxygen once more, recovery rapidly occurs and excitability returns.

OTHER EFFECTS OF OXYGEN

The difference of potential between an injured and an uninjured point of a crab's nerve is maintained for a long time in the presence of oxygen and the absence of stimulation. Stimulation rapidly reduces it, so to speak 'depolarises' the nerve surface. The potential rises again to its full value if, and only if, oxygen be present. In the absence of oxygen it falls still further. The potential difference across the surface of a nerve depends for its maintenance on the continued presence of oxygen.

Stimulation and lack of oxygen, however, are not the only means by which the potential difference can be reduced. There is normally a ratio of about 10 to 1 between the inside and the outside of a crab's nerve fibre in respect of potassium ion concentration. If we suppose that potassium is the only substance capable of penetrating the fibre surface of the crab's nerve, then this concentration ratio should lead to a potential difference of $\frac{RT}{F}\log_e 10$ which is about 58 mv. Values of 30 mv. in freshly dissected nerve are commonly observed, and sometimes more, and since a certain amount of short-circuiting must occur in the strongly conducting fluid between the fibres, the real value may well approximate to the 58 mv. required by the formula. If the hypothesis is right, the potential difference would be reduced by increasing the potassium ion concentration on the outside of the fibre. Cowan has found this to be the case. By soaking a nerve for a few seconds in sea-water to which potassium has been added, the potential difference may be varied from 30 mv. or 40 mv. down to nearly nothing as desired. The potential difference is clearly determined by the potassium ion concentration, and yet it is dependent also on the presence of oxygen. This paradoxical dependence on two such different factors has not yet been resolved: perhaps the oxygen is used in maintaining the normal properties of the surface membrane.

Another, and a most curious effect of oxygen, has recently been observed in the action of veratrine, a plant alkaloid, on frog's nerve. Applied to a muscle, this drug causes a prolonged response to a single impulse: applied to a nerve it has little effect, the action current is not greatly lengthened, the heat production is not largely increased, by soaking the frog's nerve for an hour in 1 in 50,000 veratrine solution. If, however, after the nerve has been soaked it be then asphyxiated for three or four hours until it is completely inexcitable, and if it be then revived by admitting oxygen, it shows in a striking manner a typical veratrine effect. The action current lasts hundreds of times as long, the heat production is thousands of times as great, as in the normal response of a nerve to a single shock.

Apparently the drug is usually unable to penetrate the nerve fibre sheath. When, however, the nerve has been asphyxiated, the condition of the surface has somehow been altered so that the substance which was previously held out is now able to penetrate. Oxygen is necessary for the maintenance of the normal impenetrable condition of the surface of the fibre. One naturally associated this effect with the presence of a thick sheath around the axis cylinder, and asked whether the veratrine effect could be manifested in other nerves in which no medullary sheath is present. The experiment was made by Cowan, and showed that in crab's nerve a typical veratrine effect is produced without any asphyxiation, and that the concentration of the drug required is only one thousandth of that for frog's nerve. Veratrine apparently can penetrate normally the very thin surface of a non-medullated nerve, but it is held out almost indefinitely, until the nerve is asphyxiated, by the sheath normally covering the axis cylinder of a medullated nerve.

This strange result suggested that the effect of curare should be similarly tested. Curare paralyses a muscle, in respect of impulses coming to it along its motor nerve. It was formerly thought to attack the neuro-muscular junction, though recently, on the strength of Lapicque's theories, it has been supposed to produce its effect by changing the 'time scale of excitation' of the muscle fibre, putting it out of tune so to speak with its nerve. Recent work by Rushton has shown that this hypothesis of Lapicque's is untenable, so that the manner of action of the drug was still unsolved. It was possible that curare might be a potent nerve poison but normally unable to penetrate except at the neuro-muscular junction. At this point the medullary sheath is absent. Perhaps a nerve dosed with curare but apparently unaffected, might be found effectively poisoned after asphyxiation.

The experiment was performed by Fromherz: a muscle nerve preparation was paralysed by soaking in curare, the nerve was removed and still showed a normal action current: it was then asphyxiated in hydrogen and after asphyxiation allowed to recover (if it could) in oxygen. An unpoisoned nerve treated in this way immediately gives a large action current on readmission of oxygen. The curarised nerve gave only a small one and recovered very slowly. Curare, therefore, may render a nerve incapable of responding, once it is able—as during a state of asphyxia—to get in. This may be the solution of the problem: the effect of curare is not on the 'chronaxie' of muscle, but on the part of the nerve which is exposed to the action of the drug, namely, its ending where the medullary sheath is absent.

TIME RELATIONS OF EXCITATION

All living animals, organs, or organisms, have a certain characteristic scale of time. The fibres of the wing muscle of a fly can contract hundreds of times a second, those of the leg muscle of the tortoise, differing from the fly's in no other very obvious way, may take several seconds to give a single twitch. The mouse and the man differ greatly in many of their characters and the difference is largely that of the scale of time on which respectively they live. This difference of time scale is a necessary accompaniment of a difference of size: a very small motor may do 10,000 revolutions per minute, a large one must be content with a few hundreds. One of the most important problems of physiology, and it is a problem of general, almost of philosophical interest, is what determines the scale of time of an animal or cell.

In nerve, the time required at any point for the action current to go through its cycle, the time taken in the transmission of the impulse, and the time-scale (to which I will refer later) of electric excitation, all can be varied together as we alter the condition of the cell or pass from one cell to another. These are different aspects of the same phenomenon—the transmission of the impulse. At the end of the last century it was shown by Waller, employing stimulation by condenser discharge, that there is an 'optimal' stimulus for any given tissue, in the sense that the energy in it is a minimum. He showed, and Keith Lucas following him showed, that the effectiveness of a condenser stimulus of given energy depends upon the rate of discharge of the condenser. If F be the capacity and R the resistance through which discharge takes place, the time of discharge is proportional to the product FR, and for given energy $\frac{1}{2}FV^2$ in the stimulus, the response depends on the product FR.

The use of condensers is very convenient and is generally adopted in studying the time relations of the excitatory process. The relation, however, is clearer if excitation be produced with the aid of a constant current of variable duration. If a constant current be led into an excitable tissue by two non-polarisable electrodes, in order that a stimulus of very short duration may be effective its intensity must be great, while if it lasts for a long time its intensity may be small. In the case of medullated nerve the times involved are very short, so that rather special methods of determining the duration of the constant current employed must be adopted. The relation between the duration of a constant current and the least strength required for excitation (the so-called strength-duration curve) is shown in Fig. 1.

In the case of nerve this curve is always approximately of the same form and may be defined by two parameters, the scale of time and the scale of current. The latter is of no particular interest, since most of the current is short-circuited in the fluids between the excitable elements and no strictly standard conditions for comparison can be defined. The scale of time, however, *is* important, and is very constant for a given nerve under given conditions, and the usual method of expressing it is by means of the minimum duration of a current of twice the threshold strength. This duration was called by Keith Lucas the 'excitation time' and by Lapicque the 'chronaxie', the latter term in its derivation meaning no more than the time scale of the process or tissue in question.

The excitation time of nerve depends upon many factors: (*a*) the nature of the nerve itself; it varies greatly from one fibre to another, in the same kind of way as the velocity of propagation of the impulse referred to earlier; (*b*) it is increased by a fall, decreased by a rise of temperature; (*c*) it is considerably affected by the nature of the ionic constituents in the solution around the nerve, particularly by the concentration of the calcium, and to a less extent of the potassium ion; (*d*) it depends upon the size of the fibre, being smaller in a fibre of greater diameter.

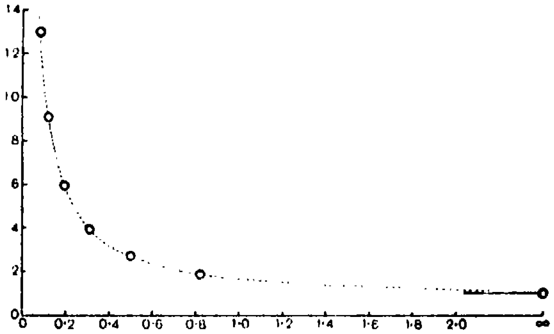

FIG. 1.

"Strength duration curve" for nerve excitation. Horizontally, duration in σ (0·001 sec.): vertically, minimum strength required.—From "Chemical Wave Transmission in Nerve", by A. V. Hill (Cambridge University Press, 1932).

The form of the strength-duration curve leads us to a discussion of the nature of electrical excitation. A constant current passed through an excitable tissue excites twice, once at the cathode at make, once at the anode at break. Unless the current be too strong, when secondary effects (for example, electrolysis and polarisation) occur, no propagated impulse is started off during the passage of a constant current. With an alternating current, however, of not too high a frequency the case is different. An impulse starts off from the cathode for each positive phase of the current, another from the anode for each negative phase. This is true up to, say, 300 a second for a frog's nerve, 700 a second for a mammalian nerve. When, however, we consider the case of a much higher frequency, say, of 100,000 to 1,000,000 per second, a different result is found. Such currents produce no response even though they be so strong that considerable warming occurs. This is commonly imagined to be due to the so-called 'skin effect', but it can readily be shown that with the high specific resistance of living tissues the skin effect does not come in until a frequency is reached far higher than that we are considering.

Let us suppose that excitation occurs, that an impulse is started, when the current outwards through the sheath of a nerve fibre in the region of the cathode attains more than a certain density (Fig. 2). When the outward current is large enough something is rendered unstable, and the state of instability is propagated as a wave. We suppose that the sheath of a fibre possesses the properties of a dielectric of high but not infinite specific resistance. The first effect of a difference of potential applied along the nerve is to charge the capacities at the anode and the cathode. The nerve, in fact, acts like a cylindrical condenser, the sheath being the dielectric between the plates.

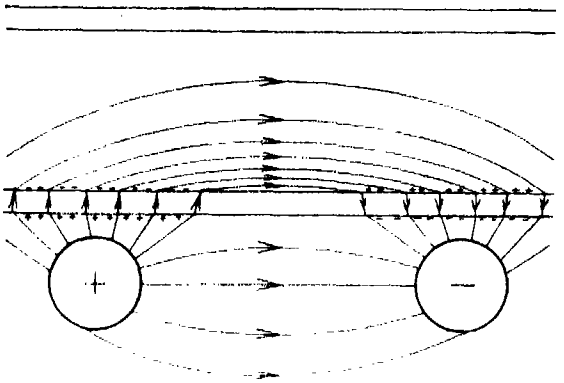

FIG. 2.
Nerve fibre with two electrodes; current flow outside, inside and through sheath.

When an alternating current of high frequency is applied between electrodes resting on the nerve the effect of each cycle is to charge, alternately in opposite directions, the condensers lying near the electrodes. Unless the current be very strong, these condensers absorb it and prevent a potential difference from arising across the dielectric of sufficient intensity to drive any considerable current through the latter. With a lower frequency, however, or with a constant current, while the first effect is still to charge the condensers, as these are charged a difference of potential arises across the dielectric by which a current is caused to pass. When this current reaches a sufficiently high density outwards at the cathode, instability is produced and excitation occurs.

With constant currents, the shorter the duration, the greater the current has to be to produce an excitatory effect. With a current of great duration the capacities in the surface of the fibre have ultimately no influence. With very short durations, however, the first effect is to charge the condensers and so to reduce the E.M.F.'s available across the dielectric. If then the applied current is cut off before the condensers are charged, the potential difference across it will be less than that which would ultimately be attained, and for excitation to occur the applied E.M.F. must be greater.

From this model an equation for the strength-duration curve can be deduced as follows:

$$C = \frac{R}{1 - e^{-t\Big/\frac{Fr\,(r_o + r_i)}{2r + r_o + r_i}}}$$

Here C is the current, t its duration, R a constant, F the capacity and r the resistance per sq. cm. of the sheath in the neighbourhood of the electrodes, r_i the resistance of the inside, r_o that of the fluids on the outside, of the nerve between the electrodes.

For the case of electrodes very far apart where $(r_o + r_i)$ is large compared with r, this equation approximates to

$$C = \frac{R}{1 - e^{-t/Fr}}$$

The important term in deciding the form of the relation is the product Fr, which is obtained by multiplying together the capacity and the resistance per square centimetre of the surface of the fibre. The relation experimentally observed in the strength-duration curve (Fig. 1) is fitted with sufficient accuracy by this equation.

If the excitation time be determined by the product of the capacity and the resistance per square centimetre of nerve fibre surface, then we should seek to explain the differences between different fibres, or between the same fibre under different conditions, by changes in the product Fr. The thinner the sheath the greater will F be, and the greater the excitation time: the lower the resistance, the shorter will be the excitation time. A rise of temperature presumably alters the excitation time by diminishing r. The absence of calcium causes a large increase in the excitation time, possibly through an increase in the resistance of the surface of the nerve. Such a change of resistance might be brought about by an alteration in the state of the emulsion of oil in water, or water in oil, of which it is possible that the sheath of the nerve is composed.

There are complications, however, in this story. It seems certain that the potassium ion has some specific function in determining the potential difference which exists between the inside and outside of a fibre and the action current by which the wave is propagated. Possibly potassium has some specific solubility in the lipoidal substances of the nerve sheath, some specific power of penetrating which other ions have not. The current outward at the cathode by which we suppose excitation to occur is probably carried by potassium ions.

This may explain a phenomenon on which I have not yet touched, that of the gradual adaptation to a slowly increasing current. It has long been known that a current which would normally be strong enough to produce excitation may not do so if its full value be reached not suddenly but slowly. If potassium be the only means of carrying current through the sheath, its continued transfer outwards at the cathode would have the effect of depleting the inside and raising its concentration on the outside, so that a back E.M.F. would be generated (determined by $\frac{RT}{F} \log \frac{C_2}{C_1}$): this might effectively prevent the further transfer of current at a time when the externally applied E.M.F. at last reached the value at which, if suddenly applied, it would excite.

Similarly, we may explain the stimulus occurring at the anode at break of a long-continued constant current. During the prolonged passage of the current the potassium ions on the outside at the anode have been depleted by carriage through the sheath until either so few are available, or the back E.M.F. is so great, that no current can run. Breaking the circuit of the applied E.M.F., the constraint at the anode is released, the unusually high ratio (potassium inside) : (potassium outside) immediately tends to right itself by the back transfer of potassium ions outwards through the membrane. This constitutes a current similar to that which occurs normally at excitation at the cathode; consequently, when the back rush of potassium ions is rapid enough, excitation occurs and an impulse starts off.

The normal function of motor nerves is to transmit impulses to the muscles, and for many years physiologists have discussed how the impulse in the nerve gets across to, and produces its effect in, the muscle fibre. Motor end-plates have been described by histologists, but their functions, and even their existence, are doubtful. It has been supposed that the electric change in the nerve which is an accompaniment of the impulse, starts the process of excitation in the muscle fibres, just as in the laboratory an impulse is started by an electric shock. This idea has led to the view that the muscle fibre and its motor nerve are normally 'isochronous', that is to say, have the same 'excitation time'; a muscle was supposed to respond to the impulse in a nerve if the latter was in tune with it, but not otherwise.

Some years before the War, Keith Lucas showed that in muscle there are two different excitable substances which he supposed were the muscle fibres themselves and the nerve twigs running to them. Lucas's experimental demonstration was denied by Lapicque who, employing different electrodes, found that the excitation time of both tissues was the same. Lucas's observations, however, have been reinstated by Rushton, and it seems doubtful whether Lapicque's claim of normal isochronism between muscle and nerve can stand. The most beautiful application of Lapicque's theory, one which was perhaps just a little too convincing because of its beauty and because it appeared to explain so much, was that of the mechanism by which paralysis is caused by curare or other drugs or by such agencies as fatigue. Normally, the impulse from the nerve passes over into the muscle. A small dose, however, of curare, or the onset of fatigue, somehow breaks the connexion, and Lapicque maintained that this was due to the fact that the curare, or the other paralysing agency, had increased the excitation time of the muscle fibre until it was no longer isochronous with its motor nerve and therefore the impulse from the latter failed to affect it. The case was like that of two tuned electric circuits, sending and receiving—if the receiver were put out of tune with the transmitter, messages were not received.

Various experiments were adduced in support of this theory, and for a time it was accepted and was in danger of becoming a dogma. Unfortunately its experimental basis seems to be at fault. The experiments on which it was founded have been repeated by Rushton and their results denied. Other experiments have been made by which the 'heterochronism' theory of curarisation has been made untenable. It is a strange thing in science to find a theory, so directly based upon apparent experimental facts, displaced by a direct denial of the facts: but so it seems to be.

THE PROPAGATED DISTURBANCE

We have considered the manner in which excitation by an electric current occurs. With every adjustment made to get the most efficient stimulus, the energy in it is still very large when compared with that set free by the nerve itself as an impulse runs along it. Electrical stimulation is very wasteful compared with the natural stimulation from point to point by which an impulse is propagated. This is not difficult to understand. The chief part of the energy of an artificial stimulus is wasted in the fluid between the electrodes outside the active region of the nerve fibres. Only that fraction of the current which, according to our hypothesis, crosses the cathode region of the surface, is effective as a stimulus. In natural stimulation, that is from point to point in the propagation of the wave, there are no electrodes and there can be no short-circuiting in the different fluids: the stimulating current, therefore (if propagation be by means of the current), is far more efficiently used.

There is a tendency to assume, as I have assumed here, that propagation of the impulse from point to point occurs through the agency of the action current which can be detected at an active point. There is no doubt that the action current has the time relations of an efficient stimulus and, properly applied, it should have the magnitude requisite for excitation. We have no picture of the manner in which the excitatory disturbance is propagated, except that which supposes that the action current at any given point 'stimulates' a neighbouring point, where in its turn a further action current is produced, which again stimulates a neighbouring point, and so on. The fact that the velocity of propagation runs parallel with the speed of development of the action current at a given point, and also inversely with the time scale of the process of excitation, strongly suggests that these three factors are linked together in some relation of cause and effect.

It must not be imagined that this self-perpetuating electro-chemical wave is analogous to those waves in physics in which no new energy is required from point to point for the transfer of the wave. In sound, or in light, energy is forced into the medium at the source but no further energy is required for the propagation. Unquestionably in nerve, as the initial heat shows, energy is liberated at each point as the impulse passes by, and, moreover, in the next thirty or forty minutes several times as much energy is set free in restoring completely the *status quo*. With this qualification, however, we can think of the propagated disturbance as some type of self-transmitting electro-chemical wave.

The problem, therefore, of its nature ultimately resolves itself into two : one is that of the change which is produced at the cathode when a current of sufficient intensity causes conditions to become unstable and some mechanism to be fired off ; the other is of the physico-chemical basis of the action current itself. If we could understand these two effects we could make a clearer picture of how the impulse is propagated. It seems likely that as the result of 'excitation' an unstable state is reached, in which the potential difference normally held at the surface of the fibre is for a moment released. It discharges until some change sets in by which the instability is reversed and the initial condition realised once more. Looked at in this way, the action current is nothing more than a momentary discharge of the resting potential, which is normally to be seen between an injured and an uninjured point of a nerve. Our problem, therefore, comes to this, what is the nature of the instability which is produced by a sufficient outward current through the nerve surface, and how is this instability rapidly reversed and the nerve surface restored to its normal state ?

The chemical reactions occurring in muscle are largely those of recovery. Lactic acid formation is involved in the restoration of creatine phosphoric acid which breaks down in activity ; oxidation and the combustion of food-stuffs are involved in the restoration of the lactic acid. In nerve we know that in any case nine-tenths of the energy liberated is involved in recovery. It is not going very much further to suppose that the remaining tenth is involved in the immediate recovery process by which the instability produced by stimulation is reversed. I should picture the primary effect as a physico-chemical one transmitting itself along the surface. The surface is rendered somehow unstable by the passage of a current outwards across it, and the instability is propagated by means of the current it releases. The return of the surface to its normal state is the result of some chemical reaction involving the liberation of free energy. Without this return no further impulse could be propagated.

MITOGENETIC RADIATION IN NERVE

The facts I have described so far are reasonably certain, though their explanation is not. I wish now shortly to refer to some others, of great importance if they are confirmed, but of which the evidence is as yet not quite convincing. During the last few years a number of papers have appeared from Moscow and Leningrad on the subject of so-called 'mitogenetic radiation'. The name implies that the radiation in question is able to cause mitosis in cells, and the approved method of detecting and measuring it is to determine the increase in the number of yeast cells in a suspension subjected to the radiation. Living organisms themselves are said to give out this radiation, particularly when active, and the analysis of the radiation is held to indicate the type of chemical reaction involved in the activity.

The yeast cells prepared in a special manner are held in a suspension which is placed in two tubes, an experimental and a control. The experimental tube is exposed through its open end to the radiation in question, the control is kept without radiation. At the end of the exposure, samples are taken and incubated, and after three or four hours the cells are killed and counted ; the excess of cells in the experimental suspension is expressed as a percentage of the control.

The radiation stated to be given out by living cells is in the ultra-violet region, chiefly between 1900 A. and 2500 A. Its amount is so relatively large that it can be split up by a quartz spectrograph into bands 10 A. wide and each band examined separately for its effect in producing the division of yeast cells.

This is not the occasion to deal with the general question of mitogenetic radiation, but a few months ago a series of papers appeared from the laboratory in Leningrad in which various results obtained from nerve are discussed. If it be true that excited nerve gives out a characteristic radiation which can be used to identify the chemical reactions involved in its activity, then indeed a new day has dawned in the very difficult problem of the physical nature of nerve activity.

In a figure in a recent paper by Kalendaroff (*Pflügers Arch.*, 231), successive spectra, analysed by a quartz spectrograph and the yeast cell indicator, refer to (1) a resting nerve, (2) ground up nerve, (3) mechanical stimulus, radiation from the point of stimulation, (4) electrical stimulus, between the electrodes, (5) injury, radiation 20 mm. from the place of injury, (6) electrical stimulus, radiation 20 mm. away, (7) mechanical stimulus, 20 mm. away. In the lower half of the figure there are spectra for (1) oxidation of pyrogallol in air, (2) glycolysis, (3) action of phosphatase, (4) splitting of creatine-phosphoric acid, (5) splitting off of ammonia from protein.

When we remember that maximal continuous stimulation of nerve does not double its resting metabolism, the variety and strength of the radiation emitted from active nerve, under the comparatively mild stimuli administered to it, are rather astonishing. A vague suspicion that the results are almost too good to be true is a little increased by a subsequent paper by Schamarina which shows an evident misunderstanding of the nature of nerve activity. It is known, and it is an obvious consequence of the existence of a refractory period following the passage of an impulse, that when two nerve impulses start at opposite ends of a nerve and meet in the middle they are unable to pass one another and both are wiped out. When a single impulse traverses the nerve the whole of the nerve goes through a phase of activity. When two impulses start at opposite ends of the nerve they meet in the middle and stop, but again the whole of the nerve has gone through the active phase. If radiation is given out as the result of nerve activity, its emission should occur equally in the two cases. Schamarina, however, expecting that because the two impulses destroy one another, therefore there should be no radiation from the point where they meet, has described experiments in support of the expectation. If the results are true, we need a new picture of the propagated disturbance in nerve.

The suspicion is strengthened by a further paper by Brainess describing the use of the same technique for the study of human fatigue. At the beginning of this remarkable paper it is stated that modern methods for investigating the phenomena of fatigue in man leave much to be desired, and that the author therefore took up the method of mitogenetic radiation in order to find a new and more accurate means of describing the state of fatigue in a factory worker. One hundred girls working in an electrical factory were examined, samples of their blood being taken at eight in the morning, at three in the afternoon and at five in the afternoon. The blood was dried on filter paper, then dissolved in distilled water and finally allowed to give out its radiation, which was measured as usual by the yeast cells. At eight in the morning the mean value of the radiation coming from their blood was 28, as measured by the percentage increase, over the control, of the number of cells in the yeast suspension. After seven hours work the girls were apparently completely exhausted, for their blood gave out no radiation at all, except in a few isolated cases. After two hours rest the radiation had risen to 28 again.

Of the social and industrial importance of these results, supposing them to be true, I need not speak, though I wonder if there are many British factory operatives who would be found completely exhausted, even of 'radiation', after seven hours work. An even stranger result follows. Not only did hæmolysed blood emit radiation which was abolished by seven hours work in a factory, but also the cornea and the conjunctiva did the same. The girls apparently had only to look at the yeast cells to set them dividing! At eight in the morning the radiation from the girls' eyes had a mean value of 24, after seven hours work it had a mean value of 4, after two hours recovery a mean value of 20. Finally—and most unromantically—it is stated that the spectrum analysis of the radiation given out by the girls' eyes showed that its only important component is that due to glycolysis!

It is not easy, in the case of the paper describing the results of the two nerve impulses meeting one another, to avoid the feeling that the expectation of a certain result has had something to do with its appearance, and it is difficult not to draw the same conclusion from the paper describing the new test for fatigue. The claims made are clearly most important if they can be verified, and one hopes that verification may soon be at hand. The difficulty in understanding nerve is largely that the changes in it are too small for ordinary chemical methods to detect. If the new methods elaborated by our Russian colleagues can throw real light on the subject, then we shall be deeply indeed in their debt. At present, however, one cannot stifle suspicion that the phenomena described may have more to do with the enthusiasm of those who describe them than with the physical nature of the nerve itself.

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A grant has been received also from the International Cancer Research Foundation, an organisation established last year in Philadelphia by Mr. William H. Donner and endowed by him with a sum of 2,000,000 dollars. Although its administrative headquarters are situated in America, the Foundation is world-wide in its scope. The income of the fund is to be applied to assist research into the causes, prevention, control, relief and cure of cancer, and this income is to be so distributed that not less than 35 per cent nor more than 50 per cent is to be allotted in countries other than the United States. The trustees have awarded a sum of £1,000 a year for a period of two years to the Cancer Hospital Research Institute in support of investigations into factors which underlie the origin of malignant growths. This sum will provide two research studentships, to one of which Mr. G. A. D. Haslewood has been appointed. The two research students will undertake the investigations of special problems in connexion with the general scheme of research now in progress at the Cancer Hospital.

Protection against Lightning

WE welcome the handbook entitled "Code for Protection against Lightning", a revised edition of which has just been published (U.S. Government Printing Office, Washington, 1933, 15 cents). The number of fatalities from lightning in the United States is insignificant in comparison with the 100,000 annually from all other accidental causes. But the suddenness with which the flash happens, and the apparent impossibility of telling where it may strike next, may well frighten the bravest. Directions are therefore given for personal conduct during thunderstorms. If it is necessary to be out of doors, it is desirable to keep away from small sheds in exposed localities, isolated trees, wire fences, hilltops and wide open spaces. Shelter can be sought in a cave, a depression in the ground, a deep valley, at the foot of a steep or overhung cliff or in a grove of trees. Best of all is to stay indoors and keep away from fireplaces, stoves and all other large metal objects. Modern buildings are safe because of the protective effects of the metal used in constructing them and the metal piping on the exterior walls. The rules for erecting lightning conductors are now practically standardised. An approved protector should be placed as near as practicable to the point of entrance of an aerial telephone wire into a building. Metal radio masts should be bonded to the nearest lightning conductor. Wooden radio masts which extend six feet or so above the highest parts of the building should be provided with a connexion to earth. In an appendix, various kinds of lightning phenomena are described and modern theories are explained. A very instructive map is given showing the average number of days on which thunderstorms occur at many stations in the United States and Canada. There are very few thunderstorms on the Pacific Coast but at Tampa in Florida the number of days per annum on which thunderstorms occur is 94.

Archæological Exploration in Oaxaca, Mexico

RECENT reports received by Science Service, Washington, D.C., from Miss Emma Reh, who is engaged in archæological exploration in Mexico, point to the possibility of further discoveries bearing on the problem of the position of Mixtec culture and the area now known as the province of Oaxaca as a connecting link between the Mayan culture to the south and Mexican culture to the north. It will be remembered that this was the problem on which S. Alfonso Caso was engaged at the time he discovered the treasure tomb of Monte Alban a year ago. Miss Reh has recently examined the sites of two ruined cities in the mountainous Mixteca area, Teposcolula and Hualmelulpan, situated eighteen miles apart, neither of which had previously been recorded on the official archæological map of Mexico. Hualmelulpan was an important centre which once dominated the road from north to south. In the inner of two pyramids, built one over the other, Indians have found a number of sculptures and idols. Among them Miss Reh reports a sculptured slab which bears the date "Thirteen Stone Knife" in the Mayan numeral system, constituting an important link with the Mayan culture to the south. Among other material is a human figure more than six feet high carved from stone, which shows a snarling mouth armed with formidable fangs. This may be the ancient Mixtec deity Tepeyolotl, "Heart of the Mountains", often represented as a tiger. Pottery heads found on the mounds and terraces range in series extending from 'Mixtecan' to 'archaic'.

Accommodation for Paying Patients at Voluntary Hospitals

THERE is a growing demand for nursing accommodation for those who, unable to pay the charges of a nursing home, desire better accommodation or more privacy than is provided in ordinary hospital wards and are willing to pay for it. King Edward's Hospital Fund for London has therefore issued a list of the 'pay beds' at hospitals making returns to the King's Fund, with particulars of the accommodation and of the normal weekly charge. The pamphlet may be obtained from the Fund, 7 Walbrook, E.C.4, price 3*d.* including postage.

Health of the British Army during 1931

IN the report on the health of the army for the year 1931 (H.M. Stationery Office. 2*s.* 6*d.* net), the Director-General, Lieut.-Gen. Fawcus, states that the health of all ranks both at home and abroad was satisfactory. With an average strength of 181,508, the principal causes of admission to hospital were influenza, malaria, and venereal diseases, with 8,324, 7,191, and 5,865 cases respectively. Tonsilitis accounts for 5,752 cases, a decrease over the previous year. Dysentery has increased somewhat. Venereal diseases have shown an almost steady fall during the last ten years, from 70 per 1,000 strength in 1922 to 33 per 1,000 in 1931.

Californian Earthquake of March 10

LATER accounts of this earthquake show that, though stronger than the Santa Barbara earthquake of 1925, it is not to be numbered among the great earthquakes of California. The epicentre is placed by the U.S. Coast and Geodetic Survey in lat. 33·7° N., long. 118·9° W., a point in the San Pedro channel, about twenty-five miles west of San Pedro Point (Science Service, Washington, D.C., March 11). The earthquake was thus probably due to a movement along the submarine San Pedro fault zone. The earthquake of July 28, 1769, also seems to have been felt most severely along the shore of San Pedro Bay and may therefore have been connected with the same fault zone.

Plastic Materials

ALTHOUGH a large number of new industries dealing with the products of plastic materials have been established in recent years, it is not yet realised the extent to which these 'substitute' materials have nowadays replaced natural products. In order to introduce plastic materials to other industries, as well as to the public, an exhibition was opened by Lord Irwin at the Science Museum, South Kensington, on April 5, which traces the course of the plastics industry from the various raw materials used in the production of plastics to the final product of artificial wood, china, horn and metals. Natural and synthetic resins, cellulose and casein are the principal bases on which the new industries depend and from these has been built up a wide variety of manufactures, ranging from aircraft accessories, buttons, dental instruments, electric insulation, fancy goods, furniture, gramophone records, combs, spectacle cases to scientific instruments and such sports requisites as golf balls and billiard balls. The term 'plastic materials' covers a number of natural and artificial chemical products, the chief property of which is that they can take shape or form under pressure. One of the most interesting features of the exhibition is a room in which the furniture and the surfaces are made entirely of plastic materials. The exhibition will remain open until the end of September.

Announcements

WING-COMDR. THE HON. MAURICE BARING, Prof. W. Langdon Brown, Regius professor of physic in the University of Cambridge, and Prof. H. H. Dodwell, professor of history of the British Dominions in Asia, School of Oriental Studies, have been elected members of the Athenæum Club under the provisions of Rule II of the Club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service.

PROF. H. E. ARMSTRONG will deliver the Huxley Memorial Lecture at the Imperial College of Science and Technology, South Kensington, on Thursday, May 4, at 5.30 p.m. His subject will be "Our Need to Honour Huxley's Will".

A DAVID ANDERSON-BERRY gold medal, together with a sum of money amounting to about £100, will be awarded in July 1935 by the Royal Society of Edinburgh to the person who, in the opinion of the Council, has recently produced the best work on the nature of X-rays in their therapeutical effect on human diseases. A similar award will be made every three years.

M. ALBERT PORTEVIN, president of the Société des Ingénieurs Civils de France, will deliver the twenty-third annual May lecture before the Institute of Metals at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1, on May 10, at 8 p.m. The subject of the lecture will be "Quenching and Tempering Phenomena in Alloys".

SILVER medals of the Royal Aeronautical Society have been awarded to Mr. D. L. H. Williams for his work in designing the Fairey long-range monoplane in which Squadron Leader Gayford and Flight Lieutenant Nicholetts made a record non-stop flight to South Africa, and to Mr. A. H. R. Fedden for his work on air-cooled engines, particularly the Bristol Pegasus engine used in the biplane in which Mr. C. F. Uwins recently attained a height of 43,976 ft.

AT the annual general meeting of the Physical Society held on March 17 the following officers were elected: —*President*, Prof. A. O. Rankine; *Vice-President*, Prof. W. Wilson; *Secretaries*, Dr. Allan Ferguson (Papers), Dr. Ezer Griffiths (Business); *Foreign Secretary*, Prof. O. W. Richardson; *Treasurer*, Mr. R. S. Whipple; *Librarian*, Dr. J. H. Brinkworth; *New Members of Council*, Prof. E. V. Appleton, Dr. L. F. Bates, Dr. L. Hartshorn.

AT the annual corporate meeting of the Institution of Chemical Engineers, held on February 17, the following officers were elected: *President*, The Right Hon. the Viscount Leverhulme; *Vice-Presidents*, Dr. H. Levinstein, Mr. H. Talbot; *Hon. Secretary*, Mr. H. W. Cremer; *Hon. Treasurer*, Mr. F. A. Greene; *Members of Council*, Col. E. Briggs, Mr. H. J. Pooley, Dr. F. S. Sinnatt; *Associate-Members*, Mr. C. C. H. Brazier, Mr. H. A. S. Gothard. The Osborne Reynolds medal for the year 1932 was presented to Mr. S. G. M. Ure, in recognition of his valuable services to the Institution as honorary editor of the *Transactions* for the past seven years. The Moulton medal for the best paper read before the Institution during the year was awarded to Dr. C. M. White, for a paper entitled "Fluid Friction and its Relation to Heat Transfer", and the Junior Moulton medal and prize of books was awarded to Dr. W. B. Hawes for a paper entitled "Some Side-lights on the Heat Transfer Problem".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A staff lecturer at the Northern Counties Training College of Domestic Science, Northumberland Road, Newcastle-upon-Tyne—The Principal (April 10). A head of the mechanical engineering department of Rutherford Technical College—The Director of Education, Education Office, Northumberland Road, Newcastle-upon-Tyne (April 22).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Spectrum and Latitude Variation of Penetrating Radiation

I HAVE made some calculations on the spectrum and latitude variation of penetrating radiation on the assumption that it consists of electrons coming to the earth from outside.

If we assume that the electrons are incident on the atmosphere uniformly in all directions, it may be shown that the number of incident electrons with a range R, is proportional to the value of xd^2I/dx^2 at a depth $x = R$. I denotes the intensity of ionisation at a depth x, the latter and the range R being measured in terms of distances travelled in a homogeneous medium. The derivation of this relation, and the exact conditions of its applicability, will be given elsewhere. By means of it, and also the relation between range and energy, we can deduce the energy spectrum of the incident electrons directly from the ionisation-depth variation.

The distribution of the electrons responsible for the ionisation at any given depth may be obtained from the distribution of the incident electrons by allowing for the absorption by the superincumbent matter. The curve in Fig. 1 represents the results obtained in this way for the incident energy spectrum (averaged over all directions) of the electrons responsible for the ionisation at sea level (76 cm. pressure).

These results depend upon the assumption that the electrons are incident on the atmosphere isotropically. The fact that the ionisation due to penetrating radiation is independent of the time, proves that the distribution of the electrons in outer space is isotropic. This is not necessarily the case at the surface of the earth, on account of the effect of the earth's magnetic field. The latter effect has been recently investigated in detail by Lemaître and Vallarta[1]. They find that for electrons of a given energy there exists a latitude, λ, above which the distribution of the electrons at the earth's surface is not at all affected by the earth's magnetic field, and is therefore isotropic. The value, λ_m, of λ, corresponding to the minimum energy, T_m, which an electron must have in order to reach sea level, is about 50°. The ionisation-depth data used here were obtained in experiments made in higher latitudes than this. It follows that the results represented by the curve in Fig. 1 are not invalidated by the assumption of isotropic incidence.

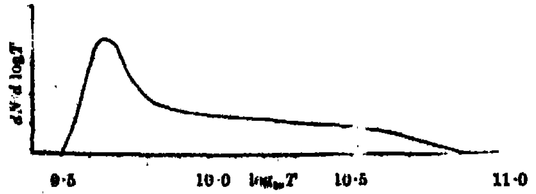

FIG. 1.—Distribution of incident energies of electrons responsible for sea level ionisation. T = energy in volts.

For latitudes $<\lambda_m$, electrons with $T > T_m$, that is, electrons with sufficient energy to reach sea-level in certain directions, are not all incident isotropically. Certain directions of incidence for certain energies are disallowed. The sea level ionisation in these cases is obtained by considering the absorbing effect of the atmosphere on the electrons incident in the allowed directions. Using the numerical results for these allowed directions given by Lemaître and Vallarta, we obtain in this way curve A, (Fig. 2), for the variation of sea level ionisation with magnetic latitude*.

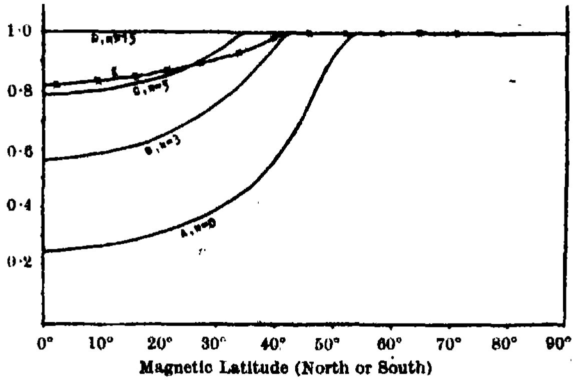

FIG. 2.—Variation of sea level ionisation with latitude. Value at poles taken as unity for calculated curves. Value at highest latitude investigated taken as unity for experimental curve.

The requirements that the falling off in the ionisation, as the equator is approached, should start suddenly at a certain latitude, and also be symmetrical about the equator, satisfies the outstanding features of the experimental results. The latter are represented in Fig. 2 by curve E (marked with crosses). This agreement makes it almost certain that at least part of penetrating radiation is due to the existence of an isotropic distribution of high-energy electrons in outer space. The existence of a fairly critical latitude arises from the calculations by virtue of, (*a*) the above result obtained by Lemaître and Vallarta that for electrons of a given energy there is no effect on their distribution at the surface of the earth above a certain latitude, (*b*) the result that the energy spectrum of the electrons concerned starts suddenly at a certain energy.

The quantitative discrepancy between curves A and E indicates either an admixture of photons, or a greater rate of dissipation of energy by the electrons than is attributed to them in the calculations. In the calculations leading to A, it is assumed that the penetrating electrons interact only with the extra-nuclear electrons of the matter traversed, and that this interaction obeys quantum mechanics. There is, however, definite experimental evidence for nuclear interaction. Assuming that the latter gives rise to a stopping-power n times the theoretical value due to extra-nuclear interaction, we obtain curve B for $n = 3$, and curve C for $n = 5$. If the nuclear effect consists in the ejection from the nucleus of high-energy electrons and protons, which acquire their energy from the primary electron, then n roughly represents the average number of particles in equilibrium with one primary electron. The frequent occurrence of groups of two or more associated tracks within the relatively small dimensions of a Wilson cloud chamber, indicates that $n \sim 5$ is not improbable.

The correction to the spectrum in Fig. 1 due to the above nuclear effect consists in a lateral displacement of the curve by $+\log_{10}n$. As regards the spectrum of all the ionising particles at sea level, which have energies greater than 10^7 volts, a value of $n=5$ requires about 10 per cent of them to have energies greater than 10^{10} volts, and 2 per cent to have energies greater than 10^{11} volts. These estimates assume that the secondary particles have energies between 10^7 and 10^{10} volts.

E. J. WILLIAMS.

Physical Laboratories,
University of Manchester.
Feb. 25.

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* Certain approximations were made in the calculations. The resulting possible errors in the calculated curves, and also the extent to which curve *E* is not an exact representation of the experimental results, are not of a magnitude which affects the present discussion.

[1] *Phys. Rev.*, Jan. 15, 1933.

Absorption Spectrum of the Vitamin E Fraction of Wheat-Germ Oil

So far as we are aware, the only attempt to investigate the absorption spectrum of vitamin E hitherto published is that of Evans and Burr[1], who reported that the vitamin E fraction of wheat-germ oil, while having high general absorption, did not give any definite bands that might help in following the concentration of the vitamin. We have now re-examined this point and have obtained results of a more promising character.

The absorption bands given by the untreated wheat-germ oil were so numerous and diffuse that it was difficult to disentangle them. At the temperature of liquid air, however, the broad diffuse bands became sharper and many of them showed detailed structure, so that the task of analysing and allotting them was rendered very much easier. A description of the bands shown by the non-vitamin fractions will be given elsewhere. The vitamin E fraction, obtained by the saponification of the oil by alcoholic potash at 37° C., followed by extraction with ether and the removal of sterols from the non-saponifiable residue by crystallisation and precipitation by digitonin, gave the curve shown in Fig. 1. The height of the peaks is given only approximately from photometered plates.

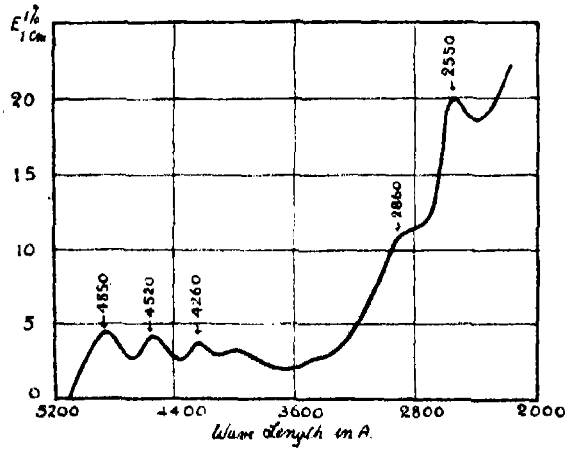

FIG. 1.

The spectrum includes three well-defined bands in the blue with maxima at 4850, 4520 and 4260 A. These bands, which were remarkably sharp even at ordinary temperatures, were detected in the original oil, but their strength was increased fifty-fold in the concentrate. In the ultra-violet (apart from a small band at 3370 A.) stronger absorption began at 3020 A. with a small step-out at 2860 A. and a well defined maximum at 2550 A., followed by general absorption from 2400 A. down.

The absorption bands were not affected by prolonged exposure of the concentrate to air or oxygen at room temperature, while the only effect of hydrogen peroxide was to increase slightly the absorption in the far ultra-violet at 2400 A. A stream of 10 per cent ozone, however, passed for a few seconds destroyed both the visible bands and the incipient absorption in the ultra-violet at 3020 A. and 2860 A. The band at 2550 A. was more resistant and was little changed. More prolonged ozonisation caused heavy continuous absorption in the ultra-violet.

The concentrate was not sensitive to light of wavelengths longer than 4000 A., but exposure to the full light of a mercury arc for a period of 45 minutes destroyed the bands in the visible spectrum as well as the incipient absorption at 3020 A. and 2860 A. The band at 2550 A. was, however, again but little changed.

Experiments on the selective destruction of the various bands by monochromatic irradiation, on the correlation of the strength of bands with biological activity, and on the absorption bands of concentrates of vitamin E from various sources are now in progress.

PHILIP BOWDEN.
Laboratory of Physical Chemistry,
Cambridge.

T. MOORE.
Nutritional Laboratory, Cambridge.
March 10.

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[1] Evans and Burr, "Memoirs of the University of California", p. 144, 1927.

Polarisation of Echoes from the Kennelly-Heaviside Layer

THE object of this letter is to correct an error made by me in a letter published in NATURE of September 10, 1932, p. 398. The letter dealt with the subject of the polarisation of echoes reflected from the Kennelly-Heaviside layer. It was stated that according to the magneto ionic theory the left-hand circularly polarised ray should be more attenuated than the right-hand one. This is an error and the reverse is the case. I have to thank Prof. Appleton and Mr. Radcliffe for pointing this out in their letter to NATURE of September 24, 1932, p. 472.

An accidental reversal of a ± sign on turning over a page was the cause of the trouble. There is now no disagreement on the theoretical side. As regards the experimental results I find, on looking up my records, that at any rate in one case, the polarisation of the single surviving F_1 echo after the split echo had disappeared was measured in the period immediately following the determination of the polarisation of the components of the split echo, so that the polarisation of the survivor was without doubt the same as the polarisation of the most bent ray in the split doublet, that is, right-handed. This condition persisted, on this occasion, for most of the afternoon.

Recent experience with an improved receiver has substantially confirmed our original observations as to the opposite polarisations of split rays, but indicates that it is impossible to generalise with regard to the strength of the various types of rays.

We have had periods on which the F_1 ray is predominantly right-handed and periods when F_1 is the opposite, and again periods when F_1 alternates between right-hand and left-hand with periods of plane polarisation in between. So far as a rather limited set of observations goes, during the daytime F_1' and F_1'', the right- and left-hand circularly polarised echoes respectively, appear on the average to be of the same order of strength. F_2 and F_3 are, however, predominantly left-handed although right-handed F_2 and F_3 have occasionally been observed. The wave-length used throughout these experiments was 60 m. and the base line between transmitter and receiver was 1·2 km.

It may be of interest to note that we have been able to get echoes from a neighbouring transmitter about 50 yards from the receiver which only radiated between 0·1 and 1 watt; the received intensities varied between a fraction of a microvolt/m. and about 20 μv./m.

T. L. ECKERSLEY.

Research Department,
Marconi's Wireless Telegraph Co., Ltd.,
Chelmsford.

Acceleration of the Decomposition of Crystals of Barium Azide by the Emission from Radium Emanation

DEHYDRATED crystals of barium azide decompose at a measurable rate above 100° C. giving nitrogen as a gaseous product. There is an induction period very similar to that observed with mercury fulminate and the reaction spreads from centres of metallic barium formed on the surface and in the interior of the crystal (F. E. Harvey, unpublished). The induction period is shortened and the rate of centre formation increased if the crystals are exposed to the emission from a platinum seed containing radium emanation. At 110° C., the induction period is shortened from 120 min. to 55 min. and the rate of acceleration of the reaction trebled when the intensity of the emission from the emanation seed is about 1 m. curie.

The experiments so far carried out indicate that the acceleration of the reaction is due to an increased rate of nuclear formation. From the nuclei of metallic barium formed, the reaction spreads out at a rate which is about three times greater than for nuclei formed by thermal means.

W. E. GARNER.
C. H. MOON.

The University, Bristol.
Feb. 27.

Crystal Structure of Diphenyl Series

A COMPARISON of the results of crystal structure analyses of diphenyl, *p*-diphenylbenzene and *p*-diphenyldiphenyl gives evidence that in this series of compounds the benzene rings in each molecule are coplanar and linearly extended. The three substances crystallise in structures of $P\,2_1/a$ symmetry with unit cells which are nearly identical in the *a* and *b* directions and have the respective lengths of 9·50, 13·59 and 17·72 A. along the *c* axis. From the marked similarity not only in dimensions but also in the intensity of those reflections which are less dependent on the length of the molecule, it is apparent that there is a similarity of structure and that in each case the length of the molecule is roughly parallel to the *c* axis.

The orientation of the benzene rings in the diphenyl crystal was determined by Krishnan from magnetic susceptibility measurements and confirmed by Dhar in an X-ray study. The molecule was found to be planar and its position in the unit cell was defined. The structure of *p*-diphenylbenzene has now been determined in this Laboratory and a Fourier analysis will shortly be published. The results show that the molecule is extended in a single plane at a tilt to the axes which, though not identical with that in the above case, does involve a similar alignment of the molecules with respect to each other. Preliminary results from the study of *p*-diphenyldiphenyl indicate that a corresponding arrangement exists in this case. I should very much like to hear of higher compounds of this series which would be available for study.

A comparison of the optical properties of these compounds is of interest. In all three substances the optic axes lie in the 010 plane and one optic axis is in the field when viewed along the perpendicular to the 001 face. In each case the ray vibrating in the direction most nearly parallel to the length of the molecule is the slow ray. The three compounds are optically positive and the degree of curvature of the isogyre shows that they become increasingly positive as the molecule lengthens. This is to be expected, since, with an increasing number of phenyl groups, the chain character of the molecule becomes relatively more important than its planar character, especially as the molecules are parallel as regards their length but have their planes mutually inclined at an angle of approximately 66°. It is proposed to carry on a more detailed study of the optical and magnetic properties of the series in this Laboratory.

LUCY W. PICKETT.

Davy-Faraday Research Laboratory,
London, W.1.
March 10.

Strange Spatfall of the Common Mussel on the Common Cockle

AN interesting and unusual spatfall of the common mussel, *Mytilus edulis*, on the common cockle, *Cardium edule*, resulting in a related and dual mortality was observed in 1932 in the course of investigations on the extensive cockle beds of Cark sands at the head of Morecambe Bay. In June, heavy falls of mussel spat (5–10 mm. long) were found in several large areas on these beds, an event unprecedented in the experience of local middle-aged fishermen. At low water on these desert-like sands, the areas with mussels loomed in the distance like rocky outcrops. Such an unusual spatfall may be regarded as a natural experiment on the part of *Mytilus* to establish itself on sandy ground.

The spat had settled about and below half-tide mark actually on living cockles, which were so abundant in parts as to push one another to the surface of the sand. The fishermen were commonly taking 1 cwt. of cockles (mean length about 30 mm.) from about 10 square yards of ground at the lower levels (about 45 individuals per square foot). An important bionomic feature of these grounds is that, wherever examined, the sand was found to contain but little silt and to pass wholly through a sieve with 0·5 mm. circular holes. In November one of these areas was again visited and examined. It was found to be littered predominantly with clumps of dead cockles lying on the surface of the sand and held together by the byssus threads of recently existing mussels. A few living and moribund cockles could be found here and there among the clumps. Gaping mussel shells ranging to about 31 mm. in length remained attached in many of the clumps, while groups of ten to thirty small, living mussels (to 23 mm.) could also be found occasionally among the collections of dead cockles. It would seem that the original clumps had been worked out of the ground by wave-action and that the cockles held fast by the byssus threads had been unable to burrow again.

In view of the doubtful compatibility of sand and mussels[1] this natural experiment is of much interest. The results at the end of the summer show clearly that most of the affected *Cardium* died, and that the loss of *Mytilus* was so great as to render the spatfall a failure.

The population of *Cardium* existing on the beds consisted mainly of individuals of medium size (and age), for the frosts in the early months of 1929 destroyed such large numbers—according to local fishermen—that economic collecting became difficult in 1930. The total yield of cockles from the Lancashire and Western Sea-Fisheries District in the years 1928–32 was 20,746, 10,892, 9,195, 14,846, and 17,117 cwt. respectively, while those for the important last quarter in the year were respectively 5,816, 1,969, 5,413, 6,607, 7,601 cwt.[2] At Cark it is noteworthy that the recovery in 1932—three years after the destructive frosts—was so complete that *Cardium* was considered to be unusually abundant. These facts are of interest in connexion with other observed effects of the unusually cold weather of 1929[3].

The cockles in the clumps would appear to have died from various subjective causes, and senility may be regarded as non-significant. As very little force is apparently required to prevent the valves of lamellibranch shells opening[4] (unsuspected factors may however add somewhat to the known force) it is probable that the entangling byssus threads of the mussels frequently effected more or less permanent occlusion of the shell-valves of *Cardium*, thus tending to starvation and difficulties in respiration. The unusual exposure of *Cardium* on the surface of the sand would subject the animals to wide and unusual variations in temperature, and might very well also involve difficulties in the operation of the feeding mechanism[5,6]—even in unimpeded feeding—over a labile substratum of loose fine sand.

The failure of the mussel spatfall was no doubt partly due to the attacks of predatory fishes, but since numerous empty valves occurred in the clumps, subjective death had occurred and probably from the same causes as operated on *Cardium*. Owing to the strong tidal currents over the beds, it is probable that the water surrounding the clumps would be rarely free from suspended sandy particles, and *Mytilus* may be expected to be less well adapted for dealing with such a situation than is *Cardium*, which possesses an internal *gill-shield* against which the ingoing current would tend to impinge[5].

From the facts of this natural experiment it may be concluded that (*a*) mussel spat was present in the spring in the water over a large area of the beds in a condition to settle on suitable places; (*b*) settlement was not effected on sand; (*c*) settlement was effected on cockles in certain places where these were abundant; (*d*) the latter spatfall was a virtual failure and resulted in killing the animals used for attachment. It is a reasonable deduction from the facts that mussel spat cannot effect a settlement on fine sand consisting of particles less than 0·5 mm. in diameter, but that given a larger firm surface a temporary lodgment may be attained.

J. H. ORTON.

Zoology Department,
University of Liverpool.
March 21.

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[1] R. W. Dodgson, Fishery Invest. II, 10, 1, p. 160, 1928.

[2] J. T. Jenkins, Lancs. and Western Sea Fish. District, Quarterly Reports, Preston.

[3] J. H. Orton and H. M. Lewis, *J. Mar. Biol. Assoc.*, 17, 2; 1931.

[4] J. Johnstone, L.M.B.C. Memoir II, p. 20, 1899.

[5] J. H. Orton, *J. Mar. Biol. Assoc.*, 9, 3, 459; 1912.
C. M. Yonge, *ibid.*, 16, 2, 331; 1926.

Control of Respiratory Movements in Crustacea

WHEREAS in mammals the factors controlling lung ventilation have been intensively studied, data for respiratory control in the invertebrates are relatively scarce. The cases hitherto investigated of the environmental factors (other than temperature) which influence respiratory movements in the invertebrates have shown that sometimes both carbon dioxide excess *and oxygen deficiency act as stimulants* (snails[1], *Octopus*[2], insects[3,4]), sometimes carbon dioxide alone is effective (*Squilla*[5]), while in other cases it is oxygen alone which is responsible (*Tubifex*[6]).

We have undertaken a comparative study of the controlling factors in members of a single group of invertebrates, the Crustacea, which live in a variety of different habitats. The results are briefly as follows. Neither carbon dioxide excess nor oxygen deficiency in the water accelerates the rate of respiratory movements in the barnacle *Balanus balanoides* (opercular valves) or in *Cheirocephalus diaphanus* (limbs). Oxygen deficiency, but not carbon dioxide excess, accelerates the scaphognathite beat of the crayfish *Astacus fluviatilis* and the pleopod movements of the fresh-water isopod *Asellus aquaticus*. Both an increase in the amount of dissolved carbon dioxide in the environment and a decrease in its oxygen content quicken the pleopod beat in the amphipods *Gammarus pulex* and *G. locusta*.

It is thus clear that not only in the invertebrates generally, but even within one group, the Crustacea, there is great diversity in the response of the respiratory appendages to oxygen lack and carbon dioxide accumulation. It is not known what is the ecological significance of such differences, nor do we yet understand their physiological causes. Are respiratory centres excited by blood stimuli or by nerve impulses from chemical receptors? The small size of most invertebrates has not permitted the question of blood stimuli to be studied directly; there is evidence, on the other hand, that at least in some forms chemical receptors are operative (*Tubifex*[6], cockroach[4]).

In the amphipods which we have studied it is unlikely that a nervous reflex is involved since there is a considerable latent period before the response appears. With these animals the effects of both oxygen deficiency and carbon dioxide excess are so closely similar that a common cause is suggested, which may be a fall in blood *p*H caused in the case of oxygen lack by incomplete oxidation of acid metabolites. It is clear, however, that oxygen deficiency cannot thus act through blood *p*H in all animals, for we found that while oxygen lack accelerates the respiratory rhythm in the crayfish and in isopods, carbon dioxide excess does not do so, Respiratory control is more efficient in the fresh-water amphipod *Gammarus pulex* than in the marine species *G. locusta*, for in the former the accelerated pleopod beat is permanent at each increased carbon dioxide or diminished oxygen tension, while in the latter it is transitory. This greater efficiency may be necessary to *G. pulex* because its oxygen consumption is twice that of *G. locusta*[7].

H. MUNRO FOX.
M. L. JOHNSON.

Zoological Department,
University of Birmingham.
Feb. 28.

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[1] Dahr, *Lunds Univ. Arssk.*, 20; 1924.
[2] Winterstein, *Z. vergl. Physiol.*, 2; 1925.
[3] Stahn, *Zool. Jahrb.*, 46; 1928.
[4] Hazelhoff, *Z. vergl. Physiol.*, 5; 1927.
[5] Matula, *Pflügers Arch.*, 144; 1912.
[6] Alsterberg, *Lunds Univ. Arssk.*, 20; 1924.
[7] Fox and Simmonds, *J. Exp. Biol.*, 10; 1933.

'Raw' Weather

IN NATURE of January 7, the question is raised why moist cold air should feel 'raw'. Sir Leonard Hill, in the same issue, gives an explanation very commonly accepted in physiological circles. May I direct attention to some comments on this topic made by me in the *Journal of Physiology*, vol. 57, 1923? "The uncomfortable feeling caused by cold moist air is attributed, so far as any explanation has been given, to the moist air being a better conductor of heat than dry air. This cannot, however, be the correct explanation, for the diathermic properties of all ordinary gases and mixtures of gases are very close to each other. The cause I take to be that in moist air there is a partial equilibration of the skin gel with the vapour pressure of water in the air leading to a swelling and to a diminution of the small air spaces. The swelling is, in fact, detectable with a strong lens or with a low power of the microscope. As a result of this diminished air enclosed between the epidermic scales the conducting power of the skin is increased".

W. A. OSBORNE.

University of Melbourne.
Feb. 15.

Time Determination

I SUGGESTED a new method of observation for time determination in my letter in NATURE for October 29, 1932[1], and Mr. H. L. P. Jolly has made some interesting comments thereon[2]. My principal aim was to find a method which would be sensibly free from systematic error. Since my first communication, observations have been obtained in India with a first experimental equipment by three observers—Messrs. Mathur, Banerji and myself on seven nights each, before I came away from India on leave; and further observations on fourteen evenings have since been made by Mathur and Banerji.

With ten stars observed, the range of variation on any one evening never exceeded 0·3 sec. For precision the equipment needs to be improved before it can compete with the moving wire micrometer method, with which at Greenwich the variation between five time stars rarely reaches 0·1 sec. But as regards personality, I think the results are encouraging. They are

$$\text{M.} - \text{B.} = 0{\cdot}012 \pm 0{\cdot}010 \text{ sec.}$$
$$\text{H.} - \tfrac{1}{2}(\text{M.} + \text{B.}) = 0{\cdot}002 \pm 0{\cdot}012 \text{ sec.}$$

Personality appears to be quite as small as that found with the moving wire micrometer. Perhaps it is definitely smaller—but the observations are not yet sufficiently extensive to decide this. The method, then, promises well as regards observer's personality.

As regards systematic error due to mechanical causes, Mr. Jolly has pointed out advantages of this method owing to the reduction of mechanism, which he would like to eliminate entirely. As matters stand, the shutter is very small and its motion is minute. Its very motion may be incorporated in the wireless time signal receiving circuits and so compared directly with the rhythmic signals by the coincidence method. The shutter motion may be regarded as the clock indication of time; then only *variations* of lag of the shutter motion, occurring during star observations and time signal reception, are significant. I fancy that there should be little difficulty in keeping this variation down to a few thousandths of a second.

For geodetic purposes of determination of field longitudes, present-day requirements will be met amply if a probable error of 0·01 sec. is not exceeded, so long as systematic error also is no greater. For fixed observatories studying variation of longitude, these limits should be reduced tenfold, if results are to be on a footing with those of observations for variation of latitude.

Survey of India. J. DE GRAAFF HUNTER.

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[1] NATURE, 130, 666, Oct. 29, 1932.
[2] NATURE, 130, 964, Dec. 24, 1932.

The Borrowed Days

IN the Calendar of Nature Topics in NATURE of March 25, page 445, there is a note about this legend. No reference is made, however, to the change from the Julian calendar to the Gregorian, whereof the effect at the present time has been to cause April 10–13 new style to correspond with March 29–31 old style.

The legend itself was no doubt in full currency long before the change of calendar; witness the following passage in "The Complaynt of Scotland", published in 1549.

"There eftir i entrit in ane grene forest, to contempill the tender yong frutes of grene treis, becaus the borial blastis of the thre borowing dais of Marche had chaissit fragrant flureise of evyrie fruit tree far athwart the fieldis."

Among Scottish country folk the legend still runs in rhyme, thus:

"March says to Averil,
'I see three hoggs on yonder hill.
If ye will lend me days three,
I'll find the way to mak them dee.'
The first day it was wind and weet;
The second day was snaw and sleet;
The third day it was sic a freeze
It frose the birds' nebs to the trees.
When thae three days was past and gane,
The silly hoggs came hirpling hame."

Hoggs in Scots are not swine, but two-year-old sheep.

HERBERT MAXWELL.

Monreith,
Whauphill,
Wigtownshire.

Research Items

Chastity in Bechuanaland. Changes in the attitude of the Southern Bantu to premarital chastity and pregnancy and their cause are discussed by Dr. I. Shapera in *Africa*, vol. 6, No. 1, in the light of investigations among the BaKxatla of the Sotho-Tšwana cluster in Bechuanaland Protectorate. As among other tribes of the group, the essential element in marriage is the transfer of cattle from the family of the bridegroom to that of the bride, known under the name of *boxadi*. According to traditional practice, strict chastity used to be required of both sexes before they entered the initiation classes, and any boy who was known to have transgressed was liable to be killed while under instruction and in any event was regarded as having disgraced his family and tribe; while a girl who became pregnant had to submit to a variety of humiliations, as well as mockery from other girls, this last being the most serious deterrent of all. The child was either aborted or killed at birth. On completion of initiation, the girl was usually married at once, while the boys were drafted into regiments, and as they were permitted to marry only girls from an age-class junior to their own, marriage was postponed for some years, during which period they had access to the younger wives of other members of their family—usually of the father's younger brother. The changed attitude of the present day, characterised by looseness of morals and a much milder attitude towards the unmarried mother, is due to a variety of causes, among which are mentioned the abolition of the initiation classes at the instance of the Church, freer intercourse between the sexes before and after adolescence, the greater license of the youths awaiting admission to the regiments, the freedom in sexual matters acquired by the men while away in European employment and the preponderance in the number of women owing to the fact that many males do not return to the tribe when they once leave.

Census of Nigeria. The reports and detailed figures of the 1931 census of Nigeria have now been published in six volumes ("Census of Nigeria 1931." 1932–33. London: Crown Agents for the Colonies.) In spite of severe curtailments in field work on the score of economy, the census reveals much of interest in problems of race distribution and changes in Nigeria. In vol. 1 the results as a whole are discussed by Mr. S. M. Jacob. In the Northern Provinces, intensive counts were made in many villages throughout the area. For the rest, the figures were obtained by compilation from village lists, but on the whole are considered to have an error of not more than five per cent, and so low as one per cent in the intensive data. In the Southern Provinces, outside Lagos, there was no actual count and the figures are based on a computation derived from the number of taxable males. The margin of error is thought to be ten to twenty per cent. In Lagos, where a count was made, the error may be so high as ten per cent. The total figures for Nigeria, 19,928,000, show a seven per cent increase on those for 1921 but the 1921 figures cannot be regarded as accurate. Certain tribes appear to be increasing in number, Kanuri, Fulani, and Tuareg in the north, and Yoruba in the south, but Nupe in the north and several of the forest tribes of the Cameroons are infertile and tending to disappear. An extensive census of the southern provinces seems to be a desirable measure. A noteworthy feature is the remarkable drop in the death rate of Lagos for both native and European.

Census of Wapiti Deer in Wyoming. A co-operative count of wapiti, universally known as 'elk' in North America, was shared during the winter of 1931–32 by the U.S. Biological Survey, the Forest Service, and the Wyoming State Game Commission. Ground work was supplemented by use of an aeroplane, and the count is regarded as the most thorough yet made. It revealed the presence of 7,921 individuals on the four feeding grounds maintained by the Biological Survey, 679 on two State feeding grounds, and 11,255 spread out over the adjacent region, including national forest areas, and easily counted from the air because of a background of snow (Report of the Bureau of Biological Survey for year ended June 30, 1932). The total of 19,855 in the herd compares with 19,238 counted five years before, so that the herd appears to be maintained in almost stationary numbers.

Rodents of the Semipalatin District of Kazakstan. A paper on these rodents by B. A. Kuznetzov (*Bull. Soc. Nat. Moscou*, 41, Nos. 1–2) results from an expedition to investigate the fur trade of this part of Siberia and to study the mammalian fauna of the area, the latter only being discussed here. The distribution of the species of wild animals is shown for the various districts, some of which have mountains under perpetual snow, while others are mostly steppe. The zonality of vegetation is not necessarily accompanied by one in the distribution of local species, high mountain and steppe forms of animals often being found together. The bulk of the work is devoted to interesting systematic and biological notes on the rodents of the area. The author asserts that some forms, such as the alpine hare (*Lepus timidus*, L.) and the squirrel (*Sciurus vulgaris*, L.) are decreasing in numbers through man's activity, while others such as *Cricetus Cricetus*, L. are increasing as a result of cultivation following forest clearing.

Antennal Secretion in Insecta. Although in a few exceptional cases the antennæ of adult insects are modified for special uses such as grasping the female, they have hitherto been regarded as entirely sensory in function. In this connexion a number of antennal receptor organs have been described which are believed to respond to various external stimuli and are accordingly said to be either tactile, olfactory or auditory (Johnston's organ). It is therefore of some interest to note the recent discovery by Mr. S. Maulik (*Proc. Zool. Soc. London*, pp. 943–956; 1932) of a new and complicated type of antennal organ which he considers to be secretory in function. The organ occurs in the enlarged eighth antennal segment of the males of certain chrysomelid beetles of the genus *Agetocera*. It consists of an internal chitinised tube which opens by a well-marked external orifice on to a specialised surface. Two types of organ have been distinguished, a long, tapering tube giving off into the surrounding tissue innumerable minute unbranched tubules of identical diameter, and a larger more or less dichotomously branched tube the ramifications of which penetrate the surrounding tissue in tubules of continually decreasing diameter. The ninth segment is also modified in sympathy with the eighth but the connexion between them is unknown. The probable function of this organ is the dispersal of certain products of secretion in relation to some aspect of sex activity at present unknown.

Daffodils, Narcissi and their Hybrids. The classification of garden plants presents many difficulties which do not beset the systematy of wild flowers. The care and selection given by gardeners is responsible for new forms which become very numerous as years go by. Travellers also bring new species or varieties which add greatly to the confusion of classification whilst enriching the beauty of the garden. "A Monograph of *Narcissus*, subgenus *Ajax*", recently published by Mr. H. W. Pugsley (*J. Roy. Hort. Soc.*, **58**, pt. 1, 17–93, Feb. 1933) clears up many difficulties connected with the identity of several different types of daffodils. The history of the sub-genus *Ajax* is traced from the sixteenth century, when many varieties were already in cultivation. Two main sections of the sub-genus are now recognised · *Cyclaminopsis* and *Pseudo-narcissus*, and the latter is subdivided into six series: *Minores*, *Lutei*, *Vulgares*, *Nobiles*, *Albiflori* and *Bicolores*. Twenty-seven species are described with such detail as to be useful to the botanist, the gardener, or the geneticist.

Inheritance of Grain Colour in Oats. Various investigators, beginning with Nilsson-Ehle, have found two factors present for black grain colour in oats. In crosses carried on at the Scottish Plant Breeding Station, Mr. William Robb (*J. Genetics*, vol. 26, No. 2) finds that the varieties Bell, Black Mogul, Black Tartarian and Sir Douglas Haig are homozygous for a single black factor, giving 3:1 ratios in crosses with white varieties. In the varieties Myrtle and Black Mesdag, however, two factors, *B* (black) and *G* (grey), are present, their formula being *B B G G*. *B* is epistatic to *G* and in crosses with white varieties an almost continuous series of grain colours is obtained, indicating a cumulative action of factors similar to that found in wheat. The variety Orion is found to be homozygous also for a third factor *B*, its colour formula being *B B B′ B′ G G*. The eleven white-grained varieties of oats tested were found to be homozygous recessives with the formula *b b b′ b′ g g*.

Cyclone Season in the South Indian Ocean. The cyclone season of 1929–30 is discussed by R. A. Watson and N. R. McCurdy in *Miscellaneous Publications of the Royal Alfred Observatory*, No. 12. This is the third publication in this series dealing specially with the cyclones of the western part of the South Indian Ocean, Nos. 7 and 10 covering the periods 1927–28 and 1928–29. The season under review appears to have been a remarkable one in many ways. In December the rainfall in Mauritius was nearly twice the previous highest, several places having the huge total of more than 60 in.—nearly three times the normal fall in London in a whole year. The synoptic weather charts showed numerous depressions which, although of considerable depth, were yet without the vigour of typical tropical cyclones; even among those classified as genuine cyclones, none was notably intense. The storm of September 23–27, 1929, near Chagos Archipelago, was exceptional, first in that it originated less than 5° from the equator, and secondly, in its being only the second recorded in Mauritius so early as September during the past 119 years. The most intense cyclone gave a wind force of 10 on the Beaufort scale, corresponding with an average speed of about sixty miles an hour, at Reunion on February 2, 1930, and the lowest pressure recorded on the charts (994·6 millibars) occurred on the same day at Reunion. Such a wind speed is not uncommon in deep depressions in the neighbourhood of the British Isles; the pressure scarcely merits the description 'low'; and the event well illustrates the moderate and anomalous character of this cyclone season.

Momentum and Energy in the Special Theory of Relativity. In *Current Science* (1, No. 8, Feb. 1933) Prof. A. C. Banerji, of the University of Allahabad, considers some of the difficulties which arise when an attempt is made to combine the special theory of relativity with the ordinary ideas of momentum and energy. If the invariant masses of two particles are respectively m_1 at A and m_2 at B, and their relative velocity is v, an observer at A will estimate the total momentum of the two particles as $m_2 v (1 - v^2/c^2)^{\frac{1}{2}}$, whereas the estimate of an observer at B will be $- m_1 v (1 - v^2/c^2)^{\frac{1}{2}}$. Similar discrepancies arise in the estimate of the energy. The attempt to define the position of the centre of mass is subject to a similar difficulty, arising from the variation of the masses with their velocities, but also an additional difficulty arises from the ambiguity in the estimation of the relative distance.

Internal Conversion of γ-Rays. An account of the work of Mott, Taylor and Hulme on the internal conversion of γ-rays has recently appeared in these notes (NATURE, **131**, 99, Jan. 21, 1933). According to their results, the values of the conversion coefficient plotted against the frequency lie on one or other of two smooth curves according to whether the nuclear radiation is of dipole or quadripole type. The internal conversion data may thus be used for classifying nuclear transitions into two groups. In a paper by Ellis and Mott (*Proc. Roy. Soc.*, Feb.) the transitions of the thorium B and C bodies are studied from this point of view. According to a theory proposed by Gamow and largely verified by Ellis, the loss of an α-particle may leave the nucleus in an excited state which collapses, giving rise to a γ-ray. The number of γ-ray transitions from the excited levels is connected with the number of α-particles in the corresponding emission groups, which have been studied by Rosenblum. Knowing, then, the number of β-rays produced by internal conversion, the internal conversion coefficient may be estimated. The coefficients obtained mostly fit satisfactorily on the two curves. It is found that many of the transitions are of quadripole type and quantum numbers analogous to the azimuthal quantum number l are suggested for the levels.

Polarity of Hydrocarbon Vapours. McAlpine and Smyth (*J. Amer. Chem. Soc.*, Feb.) describe measurements of the dielectric constants of benzene, toluene, propane and propylene, all in the gaseous state. An important result is the absence of any change of polarisation with temperature in the cases of benzene and propane, which indicates that the increase previously observed with rising temperature in the case of liquids is due to decreasing intermolecular action. The zero moment found for the benzene molecule agrees with its symmetrical structure, and the zero moment for propane is consistent with the absence of moment in the higher members of the series and shows that any polarity in the C–C bonds, electrical dissymmetry caused by repulsion in the molecule or difference in electronegative character between the hydrogens on the primary and secondary carbons, is too small to measure. The small moments found for toluene and propylene are of the same magnitude as those which might arise from inductive effects in the molecules.

Efficiency of Power Stations. In a paper on "Power Station Efficiency" read to the Institution of Electrical Engineers on March 23, Mr. W. S. Burge discussed the processes involved in the generation of electricity from coal and examined the effects produced by 'releasing' the heat at various temperatures. The main factors connected with the efficiency are four. The first shows how it varies with the steam pressure and the vacuum conditions. The second shows whether the maximum efficiencies of the various components forming the plant all occur at the same time or not, and the last two the effects of regenerative feed heating and superheating. The influence of the present physical limitations of the properties of metals, owing to the high temperatures used in practice, has also to be considered. The advances in the design of turbo-alternators in recent years have been so rapid that machines are now made which run at 3,000 revolutions per minute and have a capacity greater than 100,000 horse power. In the United States, it has been proved that when powdered coal is used, automatic control is more desirable than employing workmen. In one very large installation there, it is the habit of the 'watch' engineer to visit his boiler house only twice during an eight hour shift, although there is no one else in the boiler house. Mr. Burge considers that with no extension of steam conditions beyond about 650 lb. pressure per sq. in. and a temperature of 850° F., there is still wide scope for progress by making the plant item efficiencies have their values more nearly at the same time and thus improving the operating conditions. In his opinion, there is little scope for efficiency gain by using higher steam pressures and temperatures. Concentrated effort based on pressures of about 650 lb. pressure per square inch will produce the quickest and the best returns on the capital expended.

Astronomical Topics

Canals on Mars. An article by H. Boyd Brydon on this subject has recently appeared (*J. Roy. Ast. Soc. Canada*, Feb. 1933). It is in the main a discussion of E. M. Antoniadi's recent volume on Mars, and gives reasons for differing from his conclusion that all the narrow straight markings on the planet are an illusion.

The article quotes the following sentence from G. W. Ritchey describing certain observing sites (including Flagstaff): "The conditions of atmospheric definition and transparency are at least as much superior to those at Mt. Wilson as the latter are to the average conditions at the important observatories of northern Europe and the United States. The overwhelming impressiveness, the incredible tranquillity of the night sky seen at these very high semi-desert sites are beyond all description and imagination."

It is noted that the equivalent focus of the camera used at Flagstaff for Martian photography is 180 ft. Statements are quoted from Dr. Slipher that the photographs confirm the drawings as to the existence of a network of dark linear markings, sensibly uniform and continuous along their length; the photographs include a few double canals, but these are exceedingly difficult objects.

It is pointed out that M. Antoniadi lays undue stress on the fact that some drawings of the canals do not conform strictly to the laws of perspective.

Origin of the Solar System. A note in the Astronomical Topics in NATURE of November 5, 1932, gave some account of articles by A. C. Gifford on the above subject that appeared in *Scientia* last year. The note suggested that in giving the views of Sir James Jeans as to the age of the planetary system, thousands of millions of years should be substituted for the value millions of millions, stated in his articles. Mr. Gifford now quotes a passage from Sir James Jeans's earlier writings which certainly does suggest that he then assigned a more remote epoch for the stellar appulse than a few thousands of millions of years ago. Since that passage was written, much work has been done by cosmogonists in endeavouring to determine the age of the earth and the other planets. Their work is based on both astronomical and geological considerations, notably on a study of uranium and the products of its disintegration. The results are summarised by Dr. Harold Jeffreys in his book "The Earth"; the maximum estimate is about twelve thousand million years, the minimum one about a tenth of this. It is evident that Sir James Jeans now accepts these estimates; his article on Cosmogony in the "Encyclopædia Britannica", 14th edition (1929), vol. 6, p. 492, concludes as follows: "Our sun is a member of a colony of some thousands of millions of stars, the galactic stellar system. We do not know much about the number or arrangement of stars in the outlying parts of this system, but only in the dense central regions are stars at all likely to pass close enough to one another to produce planets. And here calculation shows that under present conditions planetary systems are only likely to be produced at the rate of about one in 6,000 million years. Thus our solar system with its age of only a few thousand million years is very possibly the youngest planetary system in the whole colony. Our terrestrial civilization, with only some 6,000 years of existence behind it, is almost certainly the youngest civilization."

***Annuaire* of the Observatory of the University of Belgrade for 1933.** This *Annuaire* is a useful volume for all observatories engaged in meridian work. It gives apparent positions, at ten-day intervals throughout the year, of 240 fundamental stars for which ephemerides are not given in any other publication. There are also tables giving true sidereal time and the reduction from true to mean; the short period terms in the nutation are given for every day. There is also a list of new minor planets.

Population Problems in the Pacific*

SINCE the publication of Rivers's "Essays on the Depopulation of Melanesia" in 1922, much attention has been given to the population problem in the Pacific and the causes of the decrease in numbers of the natives. A discussion at the Sydney meeting of the Australian and New Zealand Association for the Advancement of Science afforded a welcome opportunity for taking stock of the advance that has been made in the interval towards a real understanding of the factors involved. So far as it is possible to draw any general conclusions from the observations which were reported in the discussion and the inferences drawn from them, it would appear that while the psychological factor, on which Rivers laid so much stress, is still regarded as of importance, there is a tendency to attach greater significance to food and the need for medical attention. On the other hand, it is evident that there has been some change—perhaps even in a considerable degree—in conditions since the time when Rivers's observations were made. Some of the populations appear to be approaching, or even to have attained, a state of equilibrium in their contact with Europeans. Where this is occurring, credit must undoubtedly be given to wise methods of administration.

The discussion was opened by Sir Hubert Murray, president of the Association, who was in the chair. In a communication on "Depopulation in Papua" he said that while there is no evidence of depopulation in general, there is a decline in the Eastern Division and the South-Eastern Division. The main causes he believes to be three—insufficient food-supply, disease and the passing of the old modes of life. His conclusion is that some tribes may succumb altogether, but the more resistant stocks will remain and their natural increase will be more than enough to make up the loss. He advocated the introduction of new foods rich in vitamins, and the extension of the activities of medical officers.

Mr. E. W. P. Chinnery, of the New Guinea administrative service, pointed out the necessity for a census and Mr. F. E. Williams, Government anthropologist of Papua, while arguing that the administrator must apply the conclusions reached by science, suggested certain lines of action which should be taken forthwith by the administration while scientific workers are continuing their investigations. The factors in the depopulation problem, he holds, fall into two classes, pre-European and post-European. The pre-European factors, native warfare, sorcery and certain sexual practices, act as checks and must be removed. Among post-European factors are introduced disease and the loss of interest in life, these being of major importance, while of minor importance are increasing masculinity and the decline of polygamy. He stressed the importance of the limitations of the food supply.

Prof. Raymond Firth in "Indices of a Stable Population" dealt with the population of Tikopia, where the factors of fertility are outstripping those of morbidity and the population is increasing. This is due chiefly to the fact that former checks are inoperative. Hence pressure is being put on the food supply, much to the consternation of the old men. This last aspect of the problem of population was also considered in a communication of a more general character from Prof. S. H. Roberts, who laid stress on the economic factor and advocated the intervention of the administration to secure economic regeneration. Dr. Ian Hogbin, dealing specifically with the causes of depopulation, examined the contention that the islands were becoming depopulated before the arrival of the European on the scene, and the actual evidence for an increase in the death-rate and its causes. Prof. J. Macdonald Holmes, taking into account the number of extra-territorial peoples, especially Indians and Chinese, now resident in the Pacific, also dwelt on the economic factor, and inquired whether trade relegated the native to an inferior position and broke down tribal or family organisation.

A valuable communication on "The Medical Sciences in Relation to Depopulation" by Dr. R. W. Cilento followed. He divided the effects of European intrusion on native races into three stages. In the first, attack by arms, by new diseases and by dislocation of tribal life caused an enormous decline. This stage has long passed in the Pacific. The second stage is one of partial adjustment, when the European seeks to impose his scale of values on the native. The native loses the safeguards of savagery and, as he fails to get a substitute, a state of disequilibrium follows. This is to be seen in many parts of Melanesia. Finally, either the factors for decline predominate and the native race disappears, or adjustment becomes gradually complete and the population begins steadily to increase. Of the causes of depopulation, by far the most important are disease and food deficiency. The psychological factor, Dr. Cilento believes, is not the cause of depopulation, but merely an effect. Mental lassitude and bodily weariness follow chronic disease and prevent anything but the most essential tillage of the soil, thus providing and accentuating a vicious circle by further impoverishing the diet. The attitude of hopelessness is not a primary condition resulting from the disruption of native custom. The best method of attacking the depopulation problem is by going to the root of the trouble, devoting more attention to medical services and improving native diet by providing foods rich in protein and vitamins A, C and E. The lack of fertility is correlated with the lack of vitamin E, in which native foods are especially poor.

Dr. W. M. Strong also dealt with this aspect of the problem in his communication on the "Nutritional Aspects of Depopulation and Disease". He stressed the importance of vitamins in the diet, especially of indentured labourers, and quoted cases in which beriberi and scurvy have been cured by changes of diet, while he thinks that even tuberculosis might be averted by the provision of good nourishing food. Influenza epidemics have always caused more deaths in Papua when they have followed a drought. He urged the cultivation of a greater variety of native crops.

Dr. T. Wi-Repa pointed out that since the last century, when it was feared the Maori would die out, the population has increased.

The work of the missions in relation to the question of depopulation both in the past and at the present time was discussed by the Rev. J. W. Burton and the Rev. J. S. Needham, who pointed out that the missions not only check harmful customs such as infanticide, but also provide new interests, such as organised games, which take the place of warfare.

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* From the report of a discussion on "Population Problems", Australian and New Zealand Association for the Advancement of Science, Sydney Meeting, August, 1932. *Oceania*, 3, No. 1, 91–100.

The discussion closed with an important paper by Dr. A. P. Elkin on "The Cultural and Racial Clash in Australia", which in its broader implications has a bearing on native problems in a wider field than that with which it deals immediately. He pointed out that the coming of civilisation brought about a sudden change in the environment of the aborigines of Australia. Before the advent of the white man, the aborigines had reached an almost static condition of equilibrium, which was maintained by an intricate, but logical, system of social, legal, religious and technical customs, ensuring the cohesion, solidarity and persistence of the aboriginal race in its environment. The change worked by the coming of the white man has been almost as hard, objective, and inhuman as a geographical change. Tribal and horde grounds, which were associated with the past through sacred sites and beliefs, are used by the white man for his own purposes. Being unable to perform the initiatory, historical and totemic rites in the way and at the sites sanctified by tradition, the aboriginal feels that there can be no future for him and prepares to die. Being unable to adapt himself to this new environment, he has rapidly decreased in numbers. The Australian race is another example of a type so specialised and adjusted to one environment that it cannot adapt itself to another.

Thomas Norton and the "Ordinall of Alchimy"

AS one of the earliest alchemical books in English, the "Ordinall of Alchimy" is of much interest; Dr. M. Nierenstein and Mr. P. F. Chapman are therefore to be thanked for their exhaustive inquiry (*Isis*, **18**, 290–321; 1932) into its authorship. Ashmole, in his "Theatrum Chemicum Britannicum", is the chief authority for ascribing the "Ordinall" to Thomas Norton of Bristol, who was supposed to have flourished in the fifteenth century. Ashmole's evidence for the authorship of this anonymous poem was that "from the *first word* of this *Proeme*, and the *Initiall letters* of the *six* following *Chapters* [namely, 'Tomais Norton of Briseto'] . . . we may collect the *Authors* Name and place of Residence". As for the date of the book, there is the statement at the end of the seventh chapter: "In this yeare of *Christ* One thousand foure Hundred seaventy and seaven, This Warke was begun, *Honour to God in Heaven*".

Dr. Nierenstein and Mr. Chapman, from a consideration of the language of the poem, and of the authorities quoted in it, regard the date 1477 as, in all probability, correct; and Dr. Peter Haworth, whom they consulted, says that the "Ordinall" certainly belongs to the second half of the fifteenth century. The problem of authorship is, however, more confused. Dr. Nierenstein and Mr. Chapman say that Norton's name, in connexion with the "Ordinall", became known only in 1617–18, when Michael Maier mentions him as a master of alchemy who wrote in English verse, and published a Latin version of the "Ordinall" in his "Tripus Aureus". They do not, however, notice that (according to Mrs. Singer's "Catalogue of Latin and Vernacular Alchemical Manuscripts", **2**, 556–7; 1930) two fifteenth century manuscripts of the poem exist, in which the author is described as "T. N." This would appear to afford weighty support to Ashmole's 'cipher' theory; though it does not necessarily follow that "T. N." belonged to the well-known Bristol family of which he is usually described as a member.

Dr. Nierenstein and Mr. Chapman have very carefully and thoroughly sought out the records of the Bristol Nortons, and have constructed a genealogical table of the family, covering the relevant period, so far as is necessary to establish the interrelationship of those members named Thomas. There appeared to be four Thomas Nortons, and four only, for whom any case could be made out as possible authors of the "Ordinall". Thomas Norton I was alive in 1388, and may therefore be safely rejected. Thomas Norton II is equally ruled out, as his will was proved in 1449. As to Thomas Norton IV, he was certainly dead in 1479, and it is extremely unlikely that he was alive in 1477. There remains Thomas Norton III, who, as great-grandfather of the alchemist Samuel Norton (1548–1604 ?), would seem to have the best claim, since Samuel refers to his ancestor as an alchemist. However, Thomas III also is unacceptable to Dr. Nierenstein and Mr. Chapman, who state that he was a thoroughly disreputable character, according to the Bristol records, "avoiding divine service" and spending "sermon time in the afternoon at tennis and frivolous sports". His will was dated November 26, 1513, and the authors think that he must have died soon after.

The conclusion at which Dr. Nierenstein and Mr. Chapman arrive is that Maier and Ashmole were not justified in definitely ascribing the anonymously written "Ordinall" either to "Thomas Norton" or to "Thomas Norton of Bristol". While no fault can be found with this cautious statement, it yet seems probable that Maier and Ashmole were correct; and in view of the well-known character of many alchemists, it is perhaps surprising that Dr. Nierenstein and Mr. Chapman did not consider that Thomas Norton III—who, on chronological and other grounds, is obviously eligible—has a strong claim on the very grounds of his disreputability. E. J. HOLMYARD.

Prehistoric Society of East Anglia

AT the annual business meeting of the Prehistoric Society of East Anglia held on February 18, Dr. Cyril Fox, director of the National Museum of Wales, was elected president for the year 1933, Prof. V. Gordon Childe, vice-president, and Mr. G. Maynard, of the Ipswich Museum, general secretary.

After the business meeting, specimens were exhibited and papers read. Mr. R. N. Chandler sent an account of his researches during the past six years in the basal gravel of the Swanscombe Terrace of the Thames Valley, where he had obtained more than 200 implements belonging to Stages 1 and 2 of the Clactonian culture. Fully 50 per cent of the artefacts are cores of which the chopping tool characteristic of the industry may be considered a variety. One type of tortoise core now described for the first time appears peculiar to the Clactonian of Swanscombe, while another approximates to those characteristic of Crayford. Some of the cores are remarkable for their size and weight, two described weighing 16 lb. and 19 lb. respectively. Ten types of artefacts are distinguished and the series dealt with in the present paper, and in that published in 1929, illustrate all the types of Clactonian implements so far known at Swanscombe.

A communication from Miss N. F. Layard described the discovery in the Buttermarket, Ipswich, of bone implements beneath 9 ft. of soft gravel, and at a depth of 23 ft. from the surface. A bone needle with hour-glass perforation, a bone awl, the handle of some implement, and an antler tine perforated for suspension, were associated with a human tooth and fragment of jawbone. The objects were removed from the matrix by Miss Layard, personally, in 1899, and the circumstances carefully noted at the time. It was submitted that the needle corresponded with the broken-eyed needles found by M. Didon in the Abri Blanchard, Dordogne, in an Aurignacian deposit and other late palæolithic cave deposits in France, figured by Didon and by Lartet. Mr. J. Reid Moir stated that, if actually *in situ* in the deposit described, the specimens would be of Palæolithic age. Mr. M. C. Burkitt compared the finds with those made at the Wookey Hole, which were of Late Celtic age, and doubted their greater antiquity.

Lieut. K. R. U. Todd exhibited flint implements discovered in the alluvial beds bordering the south shore of the Orwell Estuary and submerged at high tide. One industry is characterised by long blades associated with burins; one was 137 mm. in length, while a hundred measured specimens gave an average length of 67 mm. Dr. Godwin's analysis of the peat on which certain implements of early Neolithic forms rested indicated a temperate climate of post-glacial, Atlantic type, whereas the similar long blade industry found on the north shore of the estuary and described by Mr. J. Reid Moir, had been tentatively referred to the Madelenian by Prof. H. Breuil, and the measurements of the present specimens from the south bank were very near those from the type station of La Madeleine. Mr. M. C. Burkitt and Mr. Graham Clark compared the industry associated with the floor in the peat with that at Lower Halstow, and emphasised the occurrence of burins in Mesolithic times. It has to be remarked, however, that there is more than one cultural horizon in the Orwell alluvial beds, and that it is now regarded as highly probable that the long-blade industry comes from floors at lower levels than those yielding the flints for which Mesolithic associations were claimed in the discussion.

Experimental Gob Fires

THE Safety in Mines Research Board has issued papers Nos. 75 and 76, concerning gob fires, written by T. N. Mason and F. V. Tideswell (London: H.M. Stationery Office, 1933. 1*s*. net and 6*d*. net). The first of these deals with the possibility of explosions in sealed-off areas in non-gassy seams, and the second with the possibility of the revival of heating by in-leakage of air. The experiments were carried out in a special building arranged for the purpose at the Experimental Station at Buxton. This building consists of a central chamber 30 ft. square and 9 ft. high to simulate a mine goaf, circumscribed by an air-course approximately 6 ft. wide by 7 ft. high. The chamber and air-course are connected by doors 6 ft. square capable of being closed, and in one corner of the air-course there is a centrifugal blowing fan.

The first group of experiments simulated a fire in the goaf in a pack situated centrally in the goaf chamber; with an open fire it was found that there was no possibility of the formation of an inflammable atmosphere; with an enclosed fire this was found to be possible, though no inflammable atmospheres were actually produced under the conditions of the experiments. The next set of experiments simulated a gob fire developed in a roadside coal pack such as would be caused by a partly crushed pillar with a waste area behind. The most dangerous condition was when the fire was supplied with air from a leakage from intake to return, which also partly ventilated the waste.

A third set of experiments simulated fires in dirt packs adjoining a waste, the dirt containing as usual in practice approximately ten per cent of coal. Apparently no explosions occurred, but it is not safe to conclude that such conditions would never lead to the formation of an inflammable atmosphere. Special emphasis is laid on the fact that if an underground fire is to be sealed-off, the sooner and the more quickly that operation is carried out the better. The maximum danger of the formation of an explosive mixture is immediately after the sealing-off.

Paper No. 76 shows that an in-leakage of air which causes the oxygen content to rise to as little as 5 per cent (in one case 3 per cent only) usually results in a marked increase in activity of the heating. It was found that when the temperature had fallen so low as 75° C., a fire may be revived under suitable conditions. It is pointed out that although the flame of a safety lamp is extinguished when the oxygen in the air has fallen below 17 per cent, that is no guide whatever in determining whether an atmosphere is capable of extinguishing a gob fire or not.

Calendar of Nature Topics

Second Buchan Cold Spell

April 11–14.—Of the six 'cold spells' enumerated by Dr. A. Buchan, the second, April 11–14, receives the least support from either fact or folk-lore. There appears to be no popular saying associating these days with a fall of temperature, and the average daily temperatures at Greenwich from 1841 until 1930 do not reveal any marked cold period in April. An examination of the figures for the individual years at Kew Observatory from 1881 until 1923 showed that April 11–14 had been more often above the temperature to be expected at this season than below it. A different series of years might give a different result, but the inference is clear that Buchan's second cold spell has no real existence in London.

Spawning of Frogs, and a Remarkable Tadpole

The factors which determine the time of the spawning of frogs, the temperature of the air or the temperature of the water of the spawning pond or what not, have not been determined (so far as we recollect), but the range in time of the incidence of spawning suggests that the main factors might be readily discovered. In Hampshire, Gilbert White's earliest record of frogs spawning was February 28, his latest March 22; in Sussex, William Marwick's corresponding dates were February 9 and April 10; and in Cambridgeshire, Leonard Blomefield found a shorter range, March 4 to March 25, the average of nine years' records being March 16.

These observations relate to the common frog (*Rana temporaria*) in England, but in India spawning takes place about the same time, and the discovery of the eggs of *Rana afghana* in the Khasi Hills towards the end of March 1930, enabled Dr. S. L. Hora to describe the development of the curious suctorial disc by which the tadpole adheres to rock surfaces in the rapid streams in which it lives (*Trans. Roy. Soc. Edinburgh*, **57**, 469; 1932). The sucker is formed from the posterior lip of the tadpole, a lunate callous band on the under surface of the body, and lateral folds of skin which at first include the cement organs, although these disappear as the disc becomes functional. Dr. Hora thinks that the origin and development of the sucker can be explained by a series of small and gradual changes induced by recognisable factors in the environment, such as the speed of the current in which the tadpoles found themselves. The stages in the development of the disc are not necessarily correlated with the size of the specimens, as if the relative swiftness of the stream at different points provided the stimulus for the development of the disc.

Fish Cultivation in the Philippines

During April and extending to June or July occurs the spawning season of the most important of the sixteen hundred species of fishes recorded from the Philippines—the bañgos or milk-fish (*Chanos chanos*). It is by far the most common fish in the Manila market, and that because it is the product of a fish-pond industry in which a vast amount of capital, estimated at 45 million pesos, has been expended. Somewhat resembling a herring in shape and colour, though far exceeding it in size, this shiny silvery-white fish with pale steel-bluish back owes its value to a combination of qualities. It grows rapidly and may reach a length of three to four and a half feet; it is amongst the most prolific of fishes—a 30 in. female contained a little more than 3,000,000 eggs, a 44 in. specimen 5,700,000 eggs; it is wholly vegetarian and highly palatable; it is one of the few marine fishes adaptable to artificial cultivation in salt- and brackish-water ponds; and its fry is easily captured in enormous numbers (Adams, Montalban and Martin, *Philippine J. Sci.*, Jan. 1932, p. 1).

The first fish-ponds were tidal and were cut off from the sea except for an opening through which fry could enter but could not return to the sea. That uncertain method of stocking has been replaced in the more advanced fish-ponds by deliberate collection and transference of fry to specially designed ponds. A 10-hectare fish farm should accommodate 25,000–30,000 fry, at the rate of 50 fish to a square metre of pond; from these about 15,000–18,000 will reach the fingerling stage, which is transferred to growth ponds; and the final harvest may be reckoned at 9,000–11,000, or 900–1,100 per hectare. Although the bañgos reach quite a large size in the ponds, they never become mature, and breed only in the open sea.

Societies and Academies

LONDON

Physical Society, Feb. 3. F. J. W. WHIPPLE: Relations between the combination coefficients of atmospheric ions. The principal object of the paper is to put forward for consideration a formula, $\eta_{12} - \eta_{10} = 4\pi e w_1$, which indicates that the combination coefficient η_{12} for small ions and large ions of the opposite sign exceeds the coefficient η_{10} for small ions and uncharged nuclei, and further that the difference between the two coefficients depends on the mobility w_1 of the small ions. The experimental evidence for the formula is discussed as well as possible applications. G. P. THOMSON, NORMAN STUART and C. A. MURISON: The crystalline state of thin spluttered films of platinum. Films of platinum spluttered in various gases have been examined by the method of electron diffraction. They often show patterns which indicate that the small crystals are oriented with one face parallel to the surface of the specimen, the crystals being otherwise at random and in many cases the crystals are very small, of the order 5×10^{-7} cm. Some films of platinum dioxide showed crystals of the order 2×10^{-7} cm. E. V. APPLETON and R. NAISMITH: Weekly measurements of upper atmospheric ionisation. The ionisation is 2·2 times as intense on a summer noon as on a winter noon, and, in general, was slightly less in 1932 than in 1931. This reduction is due to the approach of sunspot minimum, and, with other evidence, suggests that the ionising agency from the sun varies by as much as 60 per cent during the 11-year solar period. Although ultra-violet light is accepted as the major ionising agency, thunderstorms most probably constitute one of the subsidiary causes, as previously suggested by C. T. R. Wilson. J. A. RATCLIFFE and E. L. C. WHITE: An automatic recording method for wireless investigations of the ionosphere. The Breit and Tuve method is employed, and both the transmitter and the time base at the receiver are synchronised with the A.C. mains. Some specimen records are reproduced and are used to illustrate the normal diurnal variation of equivalent height. Attention is directed to a common 'abnormal' occurrence of increase of ionisation in the lower (E) region, during the hours of darkness, without a corresponding increase in the upper (F) region, due possibly to storm clouds, as suggested by C. T. R. Wilson.

EDINBURGH

Royal Society, March 6. J. B. SIMPSON: The late-glacial re-advance moraines of the Highland border west of the River Tay. Following upon the westward retreat of the last general ice-sheet from the central valley of Scotland and an incursion of the sea when the land level was at least 90 ft. lower than now, considerable re-advances of the ice occurred on at least two occasions. The first of these is described in detail for the district between Dunblane and Perth. From varved clays the period between the retreat and the re-advance is estimated at 640 years. This re-advance is correlated with the Ra moraines of Scandinavia. A later re-advance is marked by striking terminal moraines in the Upper Forth Valley and Loch Lomond areas. E. B. BAILEY: Help from America in reading Scottish tectonics. It is now often possible, by adopting American technique, to determine on mere inspection whether a particular rock is upside down or right way up. This possibility exists wherever a rock shows graded bedding, since in each individual bed with a contrasted coarse and fine margin, the coarse margin is the older. Also wherever current bedding involves an erosional contact, the eroded rock is the older. Many fruitful applications of these two principles during recent years in Scotland and Northern Ireland were outlined. Among other discoveries it has been revealed that thinning, in the Ballachulish district, has taken place preferentially in the normal limbs of large-scale recumbent folds. This opens a new department of tectonics, wherein drag is more important than thrust. T. KERR: The pituitary in *Lepidosiren* and its development. Development is peculiar in that the external rudiment (ectophysis) of the gland originates as in teleosts and amphibians in the form of a solid ingrowth, but unlike these, later develops a cavity. The cavity persists in the adult, dividing the anterior lobe from the intermediate and posterior lobes. The adult organ is unlike that of any other class; its structure and histology are considered.

PARIS

Academy of Sciences, Feb. 20 (*C.R.*, **196**, 523–580). C. MATIGNON and M. SÉON: The action of steam on heavy petroleum oils and on certain cyclic hydrocarbons. Zirconia was used throughout these experiments as catalyst. Details of the results obtained with metaxylene, cyclohexane, cyclohexene, gas oil and mazout are given. The object of the work was to find an economical means of preparing hydrogen. A. BIGOT: The deformations of the Cambrian grits containing shingle in the neighbourhood of Cherbourg. PAUL DELENS and JACQUES DEVISME: Certain differential forms and associated metrics. N. ARONSZAJN: The decompositions of uniform functions. E. KOGBETLIANTZ: Laguerre's series. L. SANTON: Some results obtained with a supersonic blower. Study of the methods of measuring the velocities of air currents higher than the velocity of sound. With the hot wire anemometer, as the air velocity increases, the power dissipated first increases, passes through a maximum, and then decreases. J. LERAY: The movement of a viscous liquid filling space. JEAN LOUIS DESTOUCHES: Superquantification and mechanics in abstract spaces. F. HOLWECK and P. LEJAY: Contribution to the compensation of the European gravimetric network. J. DELSARTE: The binary ds^2 and the problem of Einstein. PAUL LE ROLLAND and PIERRE SORIN: A new method of determining the moduli of elasticity. MLLE. M. QUINTIN: Study of the temperature coefficient of the chain: copper, copper sulphate; mercurous sulphate, mercury. Data are given for a temperature range of 0°–46·5° C. J. E. GARSSEN: The magnetic susceptibility of some mixtures of substances of large electric moment. The magnetic susceptibility of acetone-nitrobenzene and acetone-paranitraniline mixtures is not a linear function of the concentration. Whilst a chemical combination is not impossible, it is pointed out that another explanation is possible. PIERRE AUGER and GABRIEL MONOD HERZEN: The emission of neutrons by aluminium under the action of the α-particles. Mme. Irène Curie and F. Joliot have recently shown the presence of neutrons in the radiation emitted by aluminium under the influence of the α-rays, the proof being based on the measurement of the relative absorption in lead and paraffin. These results have now been confirmed by Wilson's method. The emission of neutrons by aluminium is much rarer than that of beryllium under the same conditions, but the general characters are the same. H. MURAOUR and G. AUNIS: The laws of combustion of colloidal nitrocellulose powders. LIGOR BEY, REZAT BEY and GABRIEL VALENSI: The titimetric determination of the sugars. Systematic study of the effects of variations of the working conditions in the titration of sugars with ammoniacal copper solutions. A. TRAVERS and LU: The volumetric determination of lead. The lead is precipitated by sodium hypochlorite as the dioxide and the latter determined iodometrically. PIERRE LÉVY: The halogen indices of the aleurite oils known as China wood oils. L. ROYER: The difference which exists between a mica and a clay with respect to the possible orientation of crystals deposited on them. PAUL GAUBERT: The properties of crystals of phlorizoside (phlorizine). MLLE. M. COLANI: Artificial ridges of the valves of lamellibranchs (Northern Annam). It is concluded that twenty deposits of shells of *Placuna placenta* found in Annam have been caused by neolithic man. MME. VORMS: The anatomical characters resulting from the arrest of development in galls. S. MAHDIHASSAN: The different symbionts of the cochineal insects producing and not producing wax. PIERRE GAVAUDAN: A certain correlation between the reversibility of the phenomena of cytoplastic instability and the spontaneous disappearance of the vital colorations of the vacuome in *Ascoidea rubescens*. RAOUL LECOQ: The rôle of B avitaminosis and of the food equilibrium in the utilisation of lactose by the rat. RAOUL P. MAY: The modifications observed in the spinal cord in the case of grafting or ablation of a rudimentary posterior paw in the embryo of *Discoglossus pictus*. MAURICE LECAMP: The induction of limbs and region of regeneration in *Alytes obstetricans*. PAUL WINTREBERT: The existence, in the blastula of amphibians, of a centre of mitogenetic induction, regulating development. ETIENNE WOLFF: A new direct teratogenic method allowing the production of monsters by means of electrolytic lesions. L. LEMATTE and E. KAHANE: Silica in the organism and the siliceous particles of the blood. It is probable that a part, at least, of the silica in the blood is of respiratory origin and that it is composed of siliceous dust resisting attack. G. DELAMARE: The generators of the primary helix of the body of the polyspiral spirochætes.

SYDNEY

Royal Society of New South Wales, Nov. 2. ALMA G. CULEY: Notes on the mineralogy of the Narrabeen series of New South Wales. The percentage of heavy minerals in the Narrabeen sediments is generally low. Zircon, rutile, tourmaline and picotite are constant constituents, while magnetite and ilmenite are commonly present. Garnet, apatite, monazite, spinel and hypersthene are peculiar to the northern sediments. Galena occurs in sandstones from Mount Victoria. Authigenic minerals recognised are: anatase in perfect crystals, accompanied sometimes by brookite, leucoxene and some secondary rutile, idiomorphic barytes, chalcopyrites and pyrites. Spherulites of calcite and siderite are present in several specimens. A sandstone from Bulli Pass has perfect quartz crystals developed in capillary cavities, and also imperfect quartz crystals resulting from the enlargement of quartz grains. A mineralogical relationship between the Narrabeen series and Kamilaroi system is suspected. F. P. DWYER and D. P. MELLOR: A note on the occurrence of β-cristobalite in Australian opals. Powder photographs have shown the existence of β (high) cristobalite in Australian opals of both the precious and common varieties. In only three cases, precious opal (*Tintenbar*), wood opal and altered diatomaceous earth, does the complete pattern of β-cristobalite appear. In all others a single broad band in the position of the most intense line of the β-cristobalite pattern appears. In these specimens the crystallites are extremely small. Scarcely any change in the diffraction pattern appears when the latter class of opal is heated at approximately 1,000° C. for several hours. When heated in the presence of potassium chloride, the crystals appear to grow, since after this treatment the broad band disappears and gives way to the sharp line pattern of β-cristobalite. M. B. WELCH: Moisture content of wood. It is essential, in order to avoid gaping joints and cracks, that wood should be thoroughly seasoned before use, and the only true indication of this condition is obtained by determination of the moisture content of the wood. Wood is continually in a state of swelling and shrinkage due to absorption or loss of moisture from the atmosphere, but only within small limits. The result of a large number of tests indicates that for Sydney an average moisture content of 13·5–14 per cent denotes properly seasoned timber. V. A. BAILEY. The quantitative theory of interaction between different species of animals. A mathematical theory of animal populations, arising out of the biological analysis of Dr. A. J. Nicholson, is described in outline. The fundamental equations of the theory are stated and certain of their consequences, biologically interesting, are mentioned. The variations of the animal densities near the steady state in a special non-continuous case are determined and shown to be represented by functions of the form $Ac^t \sin (\lambda t + B)$, where A and B are constants dependent on the initial densities, and c and λ are simple functions of the host-species' power of increase F, with $c > 1$

Forthcoming Events

Saturday, April 8

GILBERT WHITE FELLOWSHIP, at 2.30.—(Annual General Meeting in the Hall of the Art-Worker's Guild, 6, Queen Square, W.C.1).—At 3, Sir John Russell: "Modern Trends in Agricultural Science".

Monday, April 10

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Discussion on "The Use of the New Grid on Ordnance Survey Maps", to be opened by Brigadier H. L. Winterbotham.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6 (Joint Meeting with the Institute of Transport).—C. J. Spencer: "Electric Trolley Omnibuses".

Wednesday, April 12

SOCIETY OF GLASS TECHNOLOGY, at 2—(in the Mappin Hall, The University, Sheffield).—Annual General Meeting.

Official Publications Received

GREAT BRITAIN AND IRELAND

Annals of the Solar Physics Observatory, Cambridge. Vol. 3, Part 2: Microphotometry of the Solar Spectrum from 4040 to 4390A. By Dr. R. V. D. R. Woolley. Pp. v+79–118. (Cambridge: At the *University Press.*) *7s. 6d. net.*

Report of the Marlborough College Natural History Society for the Year ending Christmas, 1932. (No. 81.) Pp. 72+7 plates. (Marlborough.) To Members, *3s.*; to Non-Members, *5s.*

Researches published from the Wards and Laboratories of the London Hospital during 1932. 29 papers. (London: H. K. Lewis and Co., Ltd.) *7s. 6d.* net.

City and County of Bristol: Bristol Museum and Art Gallery. Report of the Museum and Art Gallery Committee for the Period October 1st, 1931, to December 31st, 1932. Pp. 28+4 plates. (Bristol.) *2d.*

Proceedings of the Edinburgh Mathematical Society. Series 2, Vol. 3, Part 3, February. Edited by Prof. H. W. Turnbull and Dr. E. T. Copson. Pp. 151–230. (London: *G. Bell and Son, Ltd.*)

National Joint Industrial Council for the Flour Milling Industry. Technical Education Series, Pamphlet No. 9: The Wheats of Commerce. 1: *General Considerations. By Dr. E. A. Fisher and Dr.* C. R. Jones. Pp. 51. *6d.* net. Technical Education Series, Pamphlet No. 10: The Wheats of Commerce. 2: Commercial Wheat Classes. By Dr. E. A. Fisher and Dr. C. R. Jones. Pp. iii+53–104. *6d.* net. (London.)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 8, No. 2, April. Pp. 107–240. (London: Cambridge University Press.) *12s. 6d.* net.

OTHER COUNTRIES

Proceedings of the Imperial Academy. Vol. 9, No. 1, January. Pp. ii+30. (Tokyo.)

Japanese Journal of Physics. Transactions and Abstracts, Vol. 8, No. 2, February 10. Pp. iv+57–108+21–52. (Tokyo: National Research Council of Japan.)

Journal of Science of the Hiroshima University. Series A (Mathematics, Physics, Chemistry), Vol. 3, No. 1, December. Pp. 136. (Tokyo: Maruzen Co., Ltd.)

The Tôhoku Mathematical Journal. Vol. 36, Part 2, January. Pp. ii+189–397. (Sendai: Tôhoku Imperial University.)

University Observatory, Oslo. Publication No. 5: On the Theory of the Chromosphere and the Corona. By Svein Rosseland. Pp. 37. (Oslo: A. W. Broggers Boktrykkeri A.-S.)

Publications of the Observatory of the University of Michigan. Vol. 5, No. 4: The Elements and Ephemeris of Comet Dodwell-Forbes (1932n.) *By Allan D. Maxwell. Pp. 39–42. (Ann Arbor, Mich.).*

State of Connecticut. Public Document No. 24: Fifty-fifth Report of the Connecticut Agricultural Experiment Station, New Haven, for the Year 1931. Pp. xii+850+74. *(New Haven, Conn.).*

Geological Survey of Uganda. Memoir No. 3: The Volcanic Area of Bufumbira. Part 1: The Geology of the Volcanic Area of Bufumbira, South-West Uganda; with Notes on the Petrology and Economic Geology. By A. D. Combe and W. C. Simmons. Pp. xi+150+12 plates. (Entebbe: Government Printer.) *15s.*

Forest Bulletin No. 80: List of Trees and Shrubs for the Kashmir and Jammu Forest Circles, Jammu and Kashmir State. By W. J. Lambert. Pp. v+40. (Calcutta: Government of India Central Publication Branch.) 12 annas; *1s. 3d.*

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Fourth Series (Biology), Vol. 8, No. 1, February. Pp. 74+4 plates. (Tokyo and Sendai: Maruzen Co., Ltd.)

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland. Band 79, Nr. 4: The Godthaab Expedition 1928—Alcyonaria, Antipatharia and Madreporaria. By P. L. Kramp. Pp. 20. (København: C. A. Reitzels Forlag.) 1.00 kr.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 92: On the Transmissibility of Visible Light through a Cloud of Particles. By Daizo Nukiyama and Atusi Kobayasi. Pp. 307–338. 35 sen. No. 93: Hôbutumen no Onkyôgakutekino Seisitu ni tuite (On the Acoustical Properties of Parabolic Reflectors), Part 2. By Kôzi Satô and Masaaki Sasao. Pp. 339–356. 25 sen. Tôkyô: Koseikai Publishing House.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 409: Vitamin C in Japanese Green Tea. By Masataro Miura and Michiyo Tsujimura. Pp. 129–144. *20 sen. No. 410: On the* Antiscorbutic Factor in Commercially Sterilized Milk and Japanese Green Tea—An Experiment upon Monkey. By Masataro Miura and Nagayo Okabo. Pp. 145–161. 25 sen. Nos. 411–413: On the Minor Constituents of Thermoluminescent Calcite, by Shin Hata; The Absorption Spectra of Naturally Coloured Fluorites, by Jun Yoshimura; Reactivation of the Blood Forming Action of Liver by Constituents of Gastric Mucosa, by Fumito Inukai and Waro Nakahara. Pp. 163–188. 40 sen. (Tokyo: Iwanami Shoten).

Canada: Department of Mines: Mines Branch. Anhydrite in Canada: Occurrence, Properties and Utilization. By L. Heber Cole and R. A. Rogers. (No. 732.) Pp. v+89+5 plates. (Ottawa: F. A. Acland.) 20 cents.

CATALOGUES

Microscopical Preparations: Zoological and Botanical Material. (Catalogue A, eighth edition.) Pp. 112. (Manchester: Flatters and Garnett, Ltd.)

Colorimetry and Nephelometry. (Section E33.) Pp. 15. Moll Thermopiles and Vacuum Thermocouples. (Thermo 33.) Pp. 4. (Delft: P. J. Kipp and Zonen.)

Books on Various Subjects in New Condition at much Reduced Prices. (No. 465.) Pp. 24. Catalogue of a Portion of the Library of the late G. Lowes Dickinson. (No. 466.) Pp. 24. (Cambridge: Bowes and Bowes.)

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History as Science

It is given to few Commissions to earn such widespread approbation of their report as has been deservedly afforded to that of the Lytton Commission on the Manchurian dispute. Even the authoritative tributes to its fairness and impartiality from all over the world did not, however, avail to prevent a charge of bias being brought against it in the House of Commons. That such a charge could have been made is evidence of the lack of historical perspective which characterises so much of our political life to-day and so often obstructs progress towards a new international order, and above all persists in regarding as a moral issue what is now only a question of practical policy.

If this absence of historical perspective has made politicians so inept at interpreting the facts of a political situation to-day, so blind to fundamental realities, it has had no less serious consequences among the advocates of technocracy who have been eloquent of late. A grasp of the fundamental fact that the advent of power production has revolutionised the whole position of man in relation to production, and shaken his economic and social structure to its foundations, has not prevented many of its exponents from largely ignoring human values and human factors in the technical control of production and distribution which they develop. Science is only one of the factors concerned, the scientific method only one of those employed by man in his slow advance; and history affords no justification for the neglect of other methods, or for the assumption that mechanical science by itself can solve all the problems with which man is confronted. The same mistake is made to-day as was made by Bacon, who thought that the "sovereignty of man lay hid in knowledge" and that scientific discovery would ensure the fortune of the human race. Three centuries have barely yet taught us how false and dangerous is the assumption that the knowledge of how to use knowledge goes hand in hand with the growth of knowledge.

There is, in fact, something strangely similar in the attitude of those politicians who desperately strive to revert to eighteenth century ways, and ignore the immense change which has come over mankind in the last century, and in that of those who see in science a sole and sufficient guide and imagine that all man's activities can be planned on scientific lines. Each alike lacks the sense of realities and of values which the study of history is so well able to impart, and it might be fair to place the responsibility of some at least of our difficulties on the neglect of history by our politicians and men of science alike, and on their consequent failure to interpret aright the course of present-day events.

At a time when the importance of studying the human factor is being more and more realised, when men are turning against an economic system in which increased productive powers only lead to more widespread unemployment and want, the qualities of imagination and sympathy which are essential to the understanding of history are in great demand in the affairs of society or State. The very demand and provocation of the humaner qualities which history makes, renders it an invaluable counterpart to the physical or mechanical sciences. Prof. Pollard is surely right when he urges that history is the highest form of science because its subject matter is the highest form of Nature, and that it is not commonly regarded as a science because it is too complex and too human for summary treatment by axioms, rules and formulæ.

If, however, history is not an exact science, it has much in common with the exact sciences. Dr. Tennant, for example, in the "Philosophy of the Sciences", claims first place for history in systematic order of departments of science, and asserts that it gives a far more adequate mirroring of reality than the abstract schemes of the higher sciences. Its collection of data demands qualities akin to those required of every searcher after truth whatever his field of inquiry. It is in the critical interpretation of the data acquired that history calls for qualities which are so admirably fitted to redress the balance, and in the humanisation of methods of controversy history may render its greatest service. Only by its guidance can we understand the causes of the religious, moral, political, social and economic environment in which we live. Knowledge of public action in the past provides the best means of understanding public action in the present and the surest guide for the exercise of political power. The study of history provides one way of joining to the mass of human knowledge the wisdom which alone can sort out the issues and permit beneficial action. Moreover, history, being both a science and an art, requiring a scientific analysis of materials and an artistic synthesis of results, calls for just that balance of scientific and impartial judgment, and imagination and sympathy in interpretation, which are at the root of wise administration and constructive policy.

History, though more complex, is not in fact less capable of scientific treatment than physics or chemistry, and, apart from providing a background against which alone political issues can be understood or viewed in a true perspective, its study encourages the scientific spirit in which alone political issues can be profitably examined. It is for this more especially that General Smuts has made such eloquent pleas. Prof. Pollard again has pointed out, for example, that a course on the history of London would be the first introduction to the scientific investigation of its present-day problems of local government, the vastest problems of the kind with which the human intellect has ever been called upon to deal.

This spirit we search for in vain, for example, in the recent debate on the arms embargo. We see no signs of any policy beyond that calculated to serve the narrowest exigencies of the moment—no regard to the question of world order and international action, no facing of the problems which must be faced once at least if a community of nations is to demonstrate its determination not to allow the old methods of irrational force to be introduced, no hint of the impartial and scientific survey of the facts of the particular situation carried out by the Lytton Commission and before that by the Institute of Pacific Relations. The expediency which dominated the debate has no room for realism, for the fearless facing of facts, for the scientific inquiry and deliberate co-operation which alone stand between us and world disaster.

Leaving aside the fact that a study of the history of science itself often suggests exceedingly fruitful lines of research, it should be clear that science and history have a joint contribution to make to our national and international needs which we neglect at our peril, and which it is the duty of the scientific worker as of the scholar of history to emphasise with instant eloquence. Bacon's vision of man "that will live and be a citizen of the world" in "De Augmentis Scientiarum" holds out our only hope of survival, and it were idle for science apart from history to seek to enforce the lesson.

Granted the wide fields such as politics, human biology, sociology, economics and psychology, into which the application of scientific methods is long overdue, such methods alone will not bring us the solution we desire. Even when such fields of knowledge have been placed on a scientific basis, there will remain the problem of human nature, and the study of human affairs by the application of physical formulæ alone is more likely to lead to mental confusion than to order. Scientific methods assist us to ascertain and assemble our facts, to clear our minds from passion and prejudice, but they can lead us to little of the rudiments of justice, ethics, logic or literature, though it must not be forgotten that the scientific attitude of mind may even yet prove to be a much more humanising element than might at first be expected when we think of it in terms of a struggle with the forces of Nature.

In the perspective and sense of values, the appraisement of human factors which the study of history engenders, we are able to assess correctly the position and responsibility of science. From this point of view we realise that the failure of the scientific worker to accept responsibility for the consequences of his discoveries inevitably means that he must accept the repression or suppression of certain aspects of scientific truth if the human race is to survive. If his citizenship is subordinated to his science, and the growth of an international civic sense does not keep pace with the advance of knowledge, society must itself take measures to prevent the perversion of science to destructive purposes. Knowledge may require insulation and control in the same way that electric power is safeguarded and its use restricted to those who can use it aright.

We come back, therefore, to the problem of relating knowledge and power in the service of the community. If acceptance of civic responsibility by the man of science is a fundamental condition before the scientific expert can play the part in human government indicated, for example, in certain phases of the work of the technical committees of the League of Nations, universal suffrage cannot be tempered with science by the efforts of the scientific worker alone. The scientific expert will only take his rightful place in national and international government as the study of history leads both administrators and the electorate to appreciate the significance of current events and tendencies.

This is a problem of education—of imparting not merely knowledge but also understanding, in ensuring that responsibility goes hand in hand with power. It is in this sphere—the teaching of philosophy by means of examples, in supplying the needed touch of human nature, that the study of history is of supreme importance in the study of scientific politics. Imagination and insight are here as essential as in the equipment of the man of science. History, as Prof. Pollard has said, is a matter of sense as of science, of feeling as well as of fact, and it is because history is not felt that citizenship is feeble. We cannot understand why men acted unless we know how they felt; and in discovering where men failed in sympathy and understanding because they did not understand what others felt, and thus knew not what they themselves were doing, we came to the realities of history upon which good citizenship and a new world order are based. History, being both an art and a science, offers us the opportunity of harmonising the discovery and use of new knowledge in ways which permit the free expansion of the human spirit and the continuous amelioration of the lot of mankind. The scientific teaching of history, as well as the teaching of science as part of ordinary culture, are indispensable elements in that training and discipline through which alone man can acquire the self-command and the wisdom by which to regain control over events.

Chinese Medicine

History of Chinese Medicine: being a Chronicle of Medical Happenings in China from Ancient Times to the Present Period. By Dr. K. Chimin Wong and Dr. Wu Lien-Teh. Pp. xviii + 706 + 55 plates. (Tientsin: The Tientsin Press, Ltd., 1932.) G. dollars 7.50; 30*s.* net.

TO most people in Great Britain the whole story of Chinese medicine is contained in a legend and an anecdote. The legend is to the effect that, in China, a doctor is only paid for keeping his patients well, and never for attending and curing them when ill—a reflection, probably, on the old saying from the Chinese classics that "The sage does not treat those who are ill, but those who are well". The anecdote is the well-known story of the sick man who went out to seek a Chinese doctor with the fewest lanterns outside his door, it being alleged that one such lantern must be hung up for every patient who had died at the doctor's hands, and that, having at length discovered a physician with but one lantern to his discredit, he found to his chagrin that the doctor had previously attended but one patient.

These stories, apocryphal though they are, give a delightful hint as to the possible relationship between doctor and patient in the Far East, but they scarcely claim to tell the whole story of

Chinese medicine, and in the bulky and well-documented volume before us, Dr. K. C. Wong and Dr. Wu Lien-Teh (the latter, a Cambridge graduate) have endeavoured to present a connected history of medical science in China from the earliest times to the present day. To some extent the book is a misnomer, as it is far more truly a "Chronicle of Medical Happenings in China", as its sub-title suggests, than a history of Chinese medicine, nearly five-sixths of its pages being devoted to the progress of Western medicine in China since its introduction by missionaries and others at the beginning of last century. For this reason it is the earlier chapters of the book which will be read with the greatest interest, containing as they do the foundation principles upon which the system of ancient Chinese medicine was built.

In that system, accurate scientific investigation, as we understand it in the West, took little or no part, for it is a strange fact that although China has from the earliest days revered all forms of scholarship and has made noteworthy contributions in the realms of art, and literature, and political economy, she entirely missed the stream of human progress in the matter of applied science. Instead of accurate knowledge based upon experiment and research, we find strange philosophical concepts, superstitious beliefs, and magical practices mixed up with shrewd observations and records of the symptoms and progress of the more common ailments, and an extensive knowledge of herbalistic lore.

Ancient Chinese philosophy proceeded from a belief in the existence of two opposing forces, the *yang* and the *yin* (positive and negative, active and passive, hot and cold, etc.), and all functions of the body, and even the main anatomical organs, were classified under these two categories. At the same time, it was considered that there were five primary elements in Nature (metal, wood, water, fire, and earth), upon the harmonising of which peace and equilibrium depended; and disease was therefore regarded as a disturbance of this balance owing to the excessive activity of one or other of these primordial substances. The diagnosis of any complaint thus became a matter of deciding in the first place whether it was a *yang* or a *yin* disease, and, further, which of the elements was out of proportion to the remainder. Treatment was similarly directed to a restoration of this disharmony, and just as *yang* (or hot) diseases could only be cured by *yang* drugs, so also physical disturbances due to the action of one of the five elements could only be successfully remedied by medicaments of that group.

During the Han dynasty (206 B.C. to A.D. 220) Chinese medicine made marked progress, and a number of medical treatises were then written which are quoted to this day by old Chinese doctors. These works included essays and discussions upon various diseases, elaborate studies of the pulse (regarding the character and varieties of which innumerable Chinese volumes were to appear in later dynasties), and the first attempt to produce a materia medica. The study of medicine continued to develop during the next few centuries, and though the old Chinese doctors were sadly handicapped by their ignorance of anatomy and physiology, many of them gained an accurate, if empirical, knowledge of important medical facts. The famous Pen Ts'ao Kang-Mu (the monumental Chinese treatise on pharmacology published in the sixteenth century and comprising no less than fifty-two volumes) not only refers to the usage of such well-known drugs as sulphur, mercury, and rhubarb, but also mentions remedies like kaolin, chaulmoogra oil, and ephedrine, the value of which have only recently been studied by Western pharmacologists. The treatment of such diseases as cholera, leprosy, and syphilis, and the value of inoculation against smallpox were also well understood, and an occasional genius like the renowned Hwa-To even appears to have anticipated the discovery of anæsthetics and antiseptic surgery.

Such discoveries were but fitful, and were soon buried in accretions of quackery and superstition, and as the barriers that at one time guarded the right to practise medicine gradually disappeared, the prestige of the physician rapidly fell into disrepute and the Chinese doctor became nothing but a pedlar of useless and even ridiculous concoctions.

It was the arrival of Western physicians, and in particular the very valuable work carried out through the last century by a succession of devoted medical missionaries, which restored medicine to its rightful place in China, and the greater part of the volume under review consists of a detailed account of the work accomplished by these men and women in overcoming native prejudice and establishing hospitals and even medical schools in China. With the rapid changes that have taken place during the last thirty years, the Chinese educational authorities and other agencies are now taking the lead in this matter, whilst a noteworthy contribution has been made by the Rockefeller Foundation in the erection at Peiping of one of the best-equipped medical schools to be found in the Far East.

Biology and Philosophy

(1) *The Inequality of Man: and other Essays.* By J. B. S. Haldane. Pp. ix+295. (London: Chatto and Windus, 1932.) 7*s.* 6*d.* net.

(2) *Leben und Erkennen: Vorarbeiten zu einer biologischen Philosophie.* Von Prof. Gustav Wolff. Pp. 442. (München: Ernest Reinhardt, 1933.) 11.50 gold marks.

(1) PROF. J. B. S. HALDANE'S book is, as he says, a mixed bag. It consists of a number of essays, mostly short: and one piece of fiction (a thriller of correct pedigree, by John Buchan out of H. G. Wells). Some of the essays are no more than good popular journalism, some are more substantial, but all are worth reading. There is a certain unity of purpose running through them, making the book philosophical in the wide sense. This purpose is to consider the way in which scientific knowledge, or lack of it, affects human life and society. Civilisation cannot stand still but must either develop or decay. Which course it takes depends upon whether we use scientific knowledge to cut our own throats or to reorganise society. Many of the subjects dealt with by Prof. Haldane are of acute interest.

Among the more academic topics are criticisms of some of the views of Russell, Eddington and Jeans. The ordinary biologist, or any ordinary person, is afraid to dispute anything a mathematician says in case he gets snubbed for talking about mysteries beyond his comprehension. Prof. Haldane is free of such inhibitions and is therefore a valuable critic. There is just one point, however, where the reviewer would question the value of the criticism. Jeans argues that as the whole material universe is 'running down', it must have been wound up at some finite past time and must cease to run down at some finite future time. Haldane replies (pp. 165–170) that time is infinite and that the total number of different kinds of events is finite, though large, since the whole volume occupied by matter is finite and the numbers of protons, electrons and photons are finite. Therefore every possible combination of events, however improbable, must occur over and over again. It is a good debating point, but both arguments rest on the assumption that the universe possesses a determinate time axis along which we can extrapolate as far as we like. They assume that the four dimensional figure is like a cylinder with time parallel to its axis; whereas an expanding universe must be more like a cone. The apex, if it is an apex, is in the past, but there is nothing to show how to extrapolate our time axis beyond the brief period about which we have positive information.

(2) Prof. Haldane's book provides easy reading for a few hours, Prof. G. Wolff's heavy reading for many hours (and no index). Perhaps it is only insular prejudice, but the reviewer doubts if those many hours will be as well spent as those few. Prof. Wolff propounds and develops a 'vitalistic' philosophy. The issue between 'vitalism' and 'mechanism' is by now scarcely a live one. A man cannot be a one hundred per cent mechanist because he has to exclude his own mind from the mechanistic scheme; nor can he be a one hundred per cent vitalist unless he is a solipsist because he must allow some validity to the mechanistic scheme. The controversy really turns upon the minor question of where to draw the line, or else of whether there would be a line to draw unless the problem was misstated. Fortunately Prof. Wolff leaves no doubt as to where he draws the line, for he states his position at the very beginning. He considers that the living and the lifeless differ absolutely, and the difference is that living organisms are purposive or teleological while lifeless things are not (p. 19). The author does not appear to put forward any evidence for maintaining this radical division. Indeed the evidence all points the other way. The differences between a stone and a dog are obvious enough, but in the series, bacterium, filterable virus, bacteriophage, enzyme, inorganic catalyst, the difference between living and lifeless is hard to define. Moreover we must believe, if we believe anything, that at some time in the earth's history life developed out of something that was not living (cf. Haldane's essay "The Origin of Life").

Finally, if there is such a science as physiology, which many have doubted, a considerable part of that science consists in investigating by the methods of physics how it is that organisms and their parts carry out purposive processes. The physiology of the eye is an account of how it fulfils the function of sight, of how a certain pattern of structures and processes produces normal or efficient sight and how certain deviations from the pattern render the eye less effective for its purpose. The question of purpose is there throughout, but the methods are the orthodox methods of physics. It is true that the physiologist, like the engineer, makes use of terms and concepts that have no place in the classical theory of physics, as laid down by Descartes and Newton; but it is permissible to conclude that the classical theory can be revised and expanded, and not necessarily that physiology is no part of physical science.

Of course, if the natural world was split by a radical dualism such as Prof. Wolff assumes, then science would be impotent in its own domain and the philosopher might well disregard its efforts and construct a purely idealistic philosophy on subjective lines. This, in effect, seems to be what he does. In any event, the case for a purely idealistic method in philosophy is an arguable one, though the arguments do not convince everybody; but it is very doubtful whether the case is improved by pretending that what are really subjective concepts have been derived from biology.

A. D. R.

Early County Maps of England

Reproductions of Early Engraved Maps. 2: English County Maps in the Collection of the Royal Geographical Society. With Introduction and Notes by Edward Heawood. Pp. ii+14+Atlas of 21 Sheets. (London: Royal Geographical Society, 1932.)

THIS group of twenty-one reproductions, in black and white, of maps of England will be of great value to all interested in the history of cartography. The original maps were all printed from engraved copper plates; some of them were originally over-painted by hand in colours, but these admirable reproductions are necessarily made from unpainted copies. The twenty-one plates comprise one general map of England and Ireland, by an unknown author, dated 1594; nineteen county maps strictly so called; and one sheet of playing-cards, illustrated by miniature county maps. The county maps proper vary in date from Saxton's "Southamtonia" of 1575 to John Speed's version of Norden's map of Sussex, dated 1610; so that it may be said that the Royal Geographical Society has reproduced a selected group of the earlier county maps, and has not, in the present publication, reproduced any of the later and more detailed maps on larger scales, such as Roque's Surrey or Taylor's Hampshire.

An excellent feature of the present publication is that we are able to compare the work of different cartographers. Here we are given Saxton's Hampshire, which can be compared with Norden's map of the same county, on the same scale, of about twenty years later. Norden's map is more detailed but is not so pleasant or easy to read. We have also in this collection two versions of Surrey, Cheshire and Hertfordshire, and three of Sussex. One might construct a mathematical mean of some of these maps which would presumably be more reliable than any one of them.

The county maps reproduced include five by Christopher Saxton, the father of modern English mapping; three by John Norden, whose work is original and independent. Then we have Philip Symonson's map of Eastern Kent, published in 1596; and a series of seven maps, out of a known total of twelve, belonging to "a homogeneous series", of unknown authorship, dating from the early years of the seventeenth century, based generally on Saxton or Norden, with variations; then two maps prepared for Camden; two published by John Speed, copied in the case of Sussex from Norden, and in the case of Cheshire from Saxton, with some alterations. It is a rich cartographical feast.

The collection is accompanied by an introduction and detailed notes by Mr. Edward Heawood. There is much to be learnt from the remarks of this high authority, and many curious facts are brought out, with reference, for example, to the manuscript maps of William Smith, "Rouge Dragon"; or to the work of Symonson of Rochester; or to Norden's maps of nine counties, which were original productions and not copies from Saxton. Mr. Heawood tells us that the "anonymous" series, is, as regards the engraving, of the Dutch-Flemish school; and, as regards the material, is influenced by both Norden and Smith. He also remarks that although John Speed did not always acknowledge his almost complete indebtedness to Saxton or Norden, "in any case Speed did good work in assembling material otherwise scattered", and points out that Norden himself valued Speed's editorial work.

A small correction is required on p. 9, where Saxton's "Southamtonia" is described as not dated; actually the date 1575 will be found under the coat of arms in the south-east corner.

Geographers owe a debt to the Royal Geographical Society for having thus rendered accessible facsimile copies of these important early county maps, some of which are of great rarity and some unique.

Short Reviews

Modern Methods in Quantitative Chemical Analysis. By Dr. A. D. Mitchell and Dr. A. M. Ward. Pp. xi + 178. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 6s.

In this book the authors have, as they clearly explain in their preface, deliberately selected from the large number of new methods available in analytical chemistry, in order to provide, in a conveniently limited space, details of one really sound analytical procedure for each of the substances discussed. They state the principles on which they have made their selections: that methods involving the use of the sintered glass crucible are preferable to those necessarily confined to "Gooch": that the methods should be as little empirical as possible: that they should have a definite bearing on analytical practice: and that they should not involve the use of inaccessible reagents.

After a description of "Some Methods of Wide Application"—methods involving the formation of positive halogen ions, the use of adsorption indicators and oxidation-reduction indicators, oxidation with ceric sulphate, the uses of organic complexes, and the use of the Clemmens Jones 'reductor'—there follow detailed methods for the quantitative estimation of sixty-seven different elements, radicals and compounds. The book has also a table of atomic weights, dilution tables and a full index.

The excellence of the book's general production, as well as the lucidity of all its expository matter and the catholicity of the authors' analytical 'taste', combine to make this a book quite literally indispensable to all engaged in the practice of analytical chemistry. It is much to be hoped that its circulation will warrant the frequent production of new editions and supplements. A. L. B.

Die geologische Erforschung Thüringens in älterer Zeit: ein Beitrag zur Geschichte der Geologie bis zum Jahre 1843. Von Prof. Dr. B. von Freyberg. Pp. xi + 160 + 8 Tafeln. (Berlin: Gebrüder Borntraeger, 1932.) 7.50 gold marks.

The variety in the geological formations of Thüringia, and the abundance of minerals and fossils in that part of Germany, led early to the study of its natural features. So long ago as 1710, Buttner published his "Rudera Diluvii testes", which was based on observations in Thüringia; and in 1756 J. G. Lehmann gave a good description of the stratified rocks around Mansfeld, thus producing a pioneer work in stratigraphical geology. In 1761 G. C. Füchsel published a remarkable account of the geology of the country, with new ideas well in advance of the time; while between 1755 and 1773 J. Walch issued the first important large treatise on fossils. In 1820 Baron von Schlotheim's "Petrefaktenkunde" made much advance in the modern study of fossils; and in 1822 K. E. A. von Hoff began the publication of his classic work on the explanation of geological phenomena by the study of changes now taking place on the earth's surface, which was a precursor of Lyell's "Principles of Geology".

In the new volume now before us, Prof. B. von Freyberg gives an excellent account of these and other achievements of geologists in Thüringia up to the year 1843. It includes a table showing the successive advances in knowledge of the stratigraphy of the country, and is illustrated by several beautiful portraits, of which that of von Hoff will particularly interest English readers.

The History of the Phlogiston Theory. By Dr. J. H. White. Pp. 192. (London: Edward Arnold and Co., 1932.) 6s. net.

This little book, originally a thesis for the Ph.D. degree of the University of London, is written, according to the author, to dispel the mists which are gathering around our conception of the phlogiston theory: indeed, definite misstatements with regard to it are becoming increasingly common. In any event, it is useful to have in one book the full story of the wax and wane of the theory through a century of chemical history. At the outset of the eighteenth century, alchemy was flourishing and the philosopher's stone was still eagerly sought. By the end of it, quantitative chemistry had begun, chemical combination was being understood: chemistry had advanced in spite of the phlogiston theory, the work of Lavoisier had overthrown the doctrine of Stahl.

Dr. White divides his book into a dozen chapters and gives a number of references; he has been to the original material in the British Museum Library. He ends, as is proper, with some definite conclusions, of which perhaps one of the most significant is that the phlogiston theory did little to stimulate research. This must always be the prime object of any theory; even if a hypothesis be proved to be wrong, it will not have been made in vain so long as it has been productive of experimental work. We regard the essay as a useful and a fruitful one, which will repay perusal by serious students and others interested in the past of chemical science.

Die gruppentheoretische Methode in der Quantenmechanik. Von Prof. Dr. B. L. van der Waerden. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R. Courant, Band 36.) Pp. viii + 157. (Berlin: Julius Springer, 1932.) 9.90 gold marks.

The difficulties of group theory are no doubt considerable, but here is a book of reasonable size which gives a fairly elementary account of the application of the theory to quantum mechanical problems. It is now well known that Schrödinger's wave equation leads to the discrete energy levels for the hydrogen atom required by Bohr's theory of 1913, but here it is shown how group theory, when applied to angular momentum in connexion with the wave equation, leads to important conclusions as to the energy levels of more complicated systems. Quantum numbers appear in an almost magical manner.

The book may be warmly recommended to the theoretical physicist, but the experimenter may wonder whether the principles of symmetry which are involved in the group treatment could not be developed and applied with less elaborate mathematical apparatus. One is left with the feeling that considerable simplification may yet be effected in the presentation of these results, so that even a non-mathematical reader may be able to grasp the main issues. But, in the meantime, this small volume is likely to be of service to those seriously attacking the subject.

Vision and Colour Vision. By Dr. R. A. Houstoun. Pp. vii + 238. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 15*s*. net.

DURING the past twenty years, Dr. Houstoun has carried out many researches at Glasgow on the subject of vision and colour vision, and it is indeed fortunate, in these days when so much attention is given to the advertising value of a research subject, that so able a physicist is willing to work in a subject of such poor advertising value. Many physicists are too absorbed in the complexities of the atom to pay attention to the physics of vision and it would be of interest to know how many psychologists and physiologists are able to tackle the mathematics involved.

On reading this volume, which includes not only Dr. Houstoun's but also all other important work on the subject, one can well see that the author's devotion is due to the fascination of the phenomena. Studies of vision, like those of hearing, are much complicated by the power of adaptation of the organ of perception. The same result is not obtained when a red and a blue lamp are matched on a photometer bench close up to the photometer and afterwards at a great distance from it. Intensity discrimination, dark adaptation, acuity of vision, colour, flicker and fatigue phenomena all receive full treatment. After demonstrating the inadequacy of the Young-Helmholtz theory of colour vision, the author's own theory is proposed.

Evolutionist and Missionary, John Thomas Gulick: Portrayed through Documents and Discussions. By Addison Gulick. Pp. xvi + 556 + 3 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1932.) 22*s*. net.

THE Rev. J. T. Gulick, who died in 1923, was an American missionary who will be remembered for his researches on the land-shells of the Sandwich Islands. He made a large collection, and observed that there were numerous species and varieties of each genus, which were restricted not merely to the same island, but even to the same valley. He thus elaborated a theory of divergent evolution by isolation, which he discussed in papers to the Linnean Society of London and in four letters to NATURE. On this subject he corresponded with A. R. Wallace, and especially with G. J. Romanes, who gave Gulick's work a prominent place in the third volume of his "Darwin, and after Darwin" (1897).

An interesting biography of Mr. Gulick, based on his letters and papers, has now been published by his son. One chapter is devoted to his correspondence with Romanes, and another gives a general summary of his scientific work, illustrated by three beautiful plates of the land-snails of the Hawaiian Islands.

Intermediate Physics. By Dr. C. J. Smith. Pp. viii + 650. (London: Edward Arnold and Co., 1932.) 14*s*. net.

FROM the point of view of science teaching, a physics textbook of intermediate standard is of great importance because for so many students it represents the end of their acquaintance with physics, the basic experimental science. The present volume is carefully written and is well illustrated with clear diagrams and references to the applied sciences. In view of the general teaching of calculus in schools, the author has not hesitated to use the notation and occasionally the methods of the calculus. At the end of each chapter is a good selection of numerical and other examples to be worked by the student.

The author has not ventured into the controversial and difficult problem of combining a little instruction in scientific method with the instruction in physics, and the book forms a good straightforward and conventional treatment perhaps specially suitable for the student likely to continue his physics beyond the intermediate stage.

The Medical Value of Psychoanalysis. By Dr. Franz Alexander. Pp. 247. (London: George Allen and Unwin, Ltd., 1932.) 10*s*. 6*d*. net.

DR. FRANZ ALEXANDER has dedicated his book on the "Medical Value of Psychoanalysis" to his master, Sigmund Freud, and it must be admitted that the pupil has proved worthy of the master.

It is very often a thankless and difficult task to convince medical readers of the value of psychoanalytical theories and practices. The author has, however, made out a very strong case for the development and improvement of medical education by the addition of courses in medical psychology, two courses being provided for undergraduates and one for graduates.

So many behaviour problems as well as what are obviously neurotic reactions are made to appear simple by the application of psychoanalytical technique to their investigation that the great value of psychoanalysis to medicine can no longer be denied.

Milne's Theory of the Expansion of the Universe

By DR. G. C. McVITTIE

PROF. E. A. MILNE has recently put forward in these columns[1] and also elsewhere[2] a theory designed to account for the phenomenon of the recession of the spiral nebulæ on purely kinematic grounds. The basic idea of this theory is both simple and elegant and can be described as follows.

Consider a swarm of particles moving with constant, but otherwise arbitrary, velocities in an infinite Euclidean space. The swarm has spherical symmetry around a point at which we can suppose an observer A to be stationed who employs a rectangular set of axes (x, y, z) and a Newtonian time t to describe the motions of the particles. Suppose that at $t = 0$ the swarm occupies the interior of a sphere S around A, who is at $x = 0$, $y = 0$, $z = 0$, the space outside S being empty. Then as time goes on, the particles will necessarily move out of S. For example, those near the surface of S having velocities directed away from A will immediately move out of S whilst others may have to traverse a portion, or the whole, of the sphere before they get outside it. But it is obvious that, given a sufficient lapse of time, the particles will sort themselves out so that eventually only the slowest moving ones will remain inside S. All the particles will, moreover, be now receding from A. If the original distribution of the velocities was continuous and included the velocity zero, there will always be some particles left *near* to A, and in fact it is not difficult to see that the average velocity of the particles at a distance r from A at time t is r/t, so that there is an approximate correlation of velocity with distance. Thus the behaviour of the swarm will be very similar to that of the spiral nebulæ observed in Nature, practically all of which are moving away from us with velocities which increase linearly with the distance.

The above result still holds when the distribution of particles is supposed to be infinite, provided only that there is an initial concentration of particles in the neighbourhood of A.

Milne now asks the question: What must be the space and velocity distribution of such a swarm so that a second observer, A', moving relatively to A with constant velocity and using a Euclidean space-frame (x', y', z') and a Newtonian time t', should have an equivalent view of the swarm? The principle of special relativity will ensure that the views of A and A' are consistent: to make them identical, Milne puts forward an extended principle of relativity, namely, "not only the laws of nature, but also the events occurring in nature must appear the same to all observers, wherever they be, provided their space-frames and time-scales are similarly oriented with respect to the events which are the subject of observation". These two principles are sufficient to enable him to determine, purely as a problem in statistics, the space and velocity distribution function of the swarm. It is, in terms of A's co-ordinates,

$$\psi\left(\frac{Z^2}{XY}\right)\frac{dx\,dy\,dz\,du\,dv\,dw}{c^6Y^{3/2}X^{3/2}} \tag{1}$$

where

$$X=t^2-(x^2+y^2+z^2)/c^2,\quad Y=1-(u^2+v^2+w^2)/c^2,$$
$$Z = t - (ux + vy + wz)/c^2.$$

This is the number of particles counted by an observer who sees the swarm centred around himself, in the volume-element x to $x + dx$, y to $y + dy$, z to $z + dz$, having velocities lying between u and $u + du$, v and $v + dv$, w and $w + dw$. All observers, of course, are supposed to be at the origin of their space-frames. The second observer A' will have an identical picture of the swarm if, and only if, his co-ordinate system is related to that of A by a Lorentz transformation of type

$$t'=\beta(t-Vx/c^2),\quad x'=\beta(x-Vt),\quad y'=y,\quad z'=z;$$
$$\beta=(1-V^2/c^2)^{-\frac{1}{2}}. \tag{2}$$

A' then sees the swarm centred around himself, and both A and A' count the same number of particles for equal volume-elements and equal velocity-intervals in their respective co-ordinate systems. Observers of this kind we call of 'class A'.

The condition that $x = 0, y = 0, z = 0, t = 0$ for A corresponds to $x' = 0, y' = 0, z' = 0, t' = 0$ for A' is necessary for the invariance of (1) under the transformation (2) and hence is necessary for the equivalence of the two pictures of the swarm. Consider now a third observer B who is *defined* as being at rest with respect to (say) A. He uses a co-ordinate system of type

$$t''=t,\quad x''=x+a,\quad y''=y,\quad z''=z, \tag{3}$$

where a is a constant giving the distance from A to B as measured by either of them. Milne recognises that B will not have an equivalent view of the swarm and attempts to overcome this difficulty by identifying B with an observer A'' of class A who is moving past B with velocity a/t at the instant t, having been at A at time $t = 0$. But it is not easy to see how this can be justified either on mathematical or on physical grounds. It would thus appear that Milne's extended principle of relativity is equivalent to a definition of a certain class of observers, namely, those who have equivalent views of the swarm of particles. These observers all coincided with one another and with the centre of the swarm 'simultaneously' and all set their clocks to read $t = 0$ when this happened. This moment can also be supposed to correspond to the moment of greatest concentration of the swarm and is so taken by Milne.

The distribution function

$$\frac{(\text{constant})\; dx\,dy\,dz\,du\,dv\,dw}{Y\left[c^2\sum(x-ut)^2-\sum\left\{v(z-wt)-w(y-vt)\right\}^2\right]^{3/2}} \tag{4}$$

has been specially studied by Milne: it arises from a particular solution* of his equation for ψ and corresponds to the case of rectilinear motions of the particles of the swarm as viewed by an observer of class A. This is therefore the case when the interactions of the particles are neglected. It follows that at $t = 0$ there were an infinite number of particles at the origin. At any subsequent $t > 0$, particles which were initially at the origin and moving with velocity V, will have got to $r = Vt$ and evidently these particles again have an infinity in their distribution at that distance. Thus these infinities recede from the observer with velocities proportional to their distances from him. The general effect of gravitation is to remove these infinities and to replace them by density-maxima in the distribution of the particles. Thus finally we have a set of groups of the original particles which appear to any observer of class A to recede from him according to the law $r = Vt$. However, there still remain singularities in the distribution of the groups on the sphere $r = ct$, so that the latter are strongly concentrated there. Milne identifies the groups with the spiral nebulæ, thus obtaining the law of velocity of recession proportional to distance. The concentration towards $r = ct$ is shown to be consistent with the apparent uniform distribution of the nebulæ owing to the rapid diminution of brightness due to the high velocity an object acquires on approaching this bounding sphere.

From the observed correlation of 500 km. per sec. for every 3·25 million light years distance of a nebula and the law $r = Vt$, it follows that $t = 2 \times 10^9$ years have elapsed since the system of the nebulæ was at its greatest concentration.

We may in conclusion contrast Milne's theory with that based on general relativity. The latter deals only with the group of observers at rest with respect to one another, who are observing a set of particles also at rest with respect to the observers in the sense that the total momentum of the particles is assumed to be zero. The particles initially are in a state of unstable equilibrium and the expansion is due to what may be called a 'cosmical repulsion'. In Milne's theory the particles are initially in motion and are not in an equilibrium state. The observers considered are not at rest with respect to each other. The expansion is simply due to the fact that the particles in a certain region have higher velocities on the whole than those elsewhere. Both theories are in accordance with observation and it seems impossible to decide definitely for or against either so long as the phenomenon of the recession of the nebulæ, in isolation from all other phenomena, is to be the only criterion.

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* It appears as the *only* solution in the paper quoted in (2). Prof. Milne has since discovered others.

[1] NATURE, **130**, 9–10, July 2, and 507–508, Oct. 1, 1932.

[2] *Z. Astrophysik*, **6**, 1–96, Jan., 1933. See also E. Freundlich, *Naturwiss.*, **21**, 54–59, Jan. 27, 1933.

Nitrogen-Uptake of Plants

PROGRESS, due to the abandonment of traditional beliefs, is occurring to-day in agriculture as well as in other branches of applied science. At one time it was generally held that ammoniacal nitrogen had first to be converted into nitric nitrogen before it could be taken up by plants, but we now know of many plants that take up ammoniacal nitrogen directly; and at the present time doubt is being cast on a doctrine which has persisted since the days of Liebig and Boussingault, namely, that organic nitrogen has first to be 'mineralised' before it becomes available as food for plants. The work done by Prof. A. I. Virtanen and his collaborators at Helsingfors during the past few years has provided important evidence that at least some plants directly and readily assimilate organic nitrogenous compounds, and a useful summary of this work was given recently by Prof. Virtanen in lectures delivered to the Netherlands Agricultural Society at Wageningen and to the Chemical Society of Zurich.

Earlier experiments showed that certain legumes, for example, red clover, did not grow so well when the nitrogenous food derived from the root nodules was replaced entirely by ammonium nitrate, but that peas utilised both forms of nitrogen equally well, whilst white clover responded better to ammonium nitrate than to the food provided by the nodule bacteria. These and other observations led to the hypothesis that legumes take up their nitrogen from the nodules in the form of organic compounds, and that these compounds constitute the best form of nitrogen-nutrition for certain legumes. It was also found that these compounds diffuse into the surrounding soil, from which they are taken up by growing plants, like *Gramineæ*. Both pot and field experiments have shown that, when the pH of the soil does not fall below 6, one pea plant can provide sufficient nitrogen for two oat plants, but if the ratio of oats to peas is greater than two to one, both plants suffer from lack of nourishment.

Investigations were then made using sterilised sand and pea seeds inoculated with nodule bacteria, and it was found that the nitrogenous matter that diffused into the sand consisted entirely of organic compounds, which were almost equal in amount to the nitrogen compounds directly taken up from the nodules. It was also established that nitrogen compounds diffuse into the soil from young and fresh root nodules of the alder tree, thereby enabling the latter to assist the growth of other trees.

Analysis of the substances that diffused into sterile quartz sand from the roots of pea plants that had been strongly inoculated showed the chief constituent to be amino-acids: in percentages of total nitrogen, amino-nitrogen 77·4, ammonia-nitrogen 0, amido-nitrogen 3·30, nitrogen in volatile bases 2·73, humin-nitrogen 2·05.

The question then arose whether non-legumes could take up and utilise these nitrogen compounds directly, and to solve it pea and barley plants were grown together in sterile sand contained in three-necked Woulff bottles, the pea seeds being inoculated, and each kind of plant being made to grow out through a neck of the bottle. The nutrient solution used contained no nitrogen. The barley plants grew excellently, but in the control experiment, in which the pea seed was not inoculated, they failed to grow. It was also found that barley, as well as peas, grew exceedingly well right up to the flowering or fruiting stage when they were fed with an aqueous extract of a low moorland soil that contained no ammonia or nitric nitrogen; they also grew well when they were fed in sterile culture with peptone (Witte) as their sole source of nitrogen. It is therefore concluded that higher plants can take up and utilise directly organic nitrogen compounds present in soils before their nitrogen is mineralised by bacteria or other micro-organisms.

The nature of the organic nitrogenous compounds that are of value to plants, as well as their percentage utilisation, is now being investigated. Earlier experiments in which red and white clovers were grown under sterile conditions inside glass flasks showed that red clover responded well to hydrolysed casein and to aspartic acid, and less well to ammonium salts and nitrate, whereas with white clover the results were exactly opposite. In these experiments the hydrogen ion concentration of the nutrient solutions containing hydrolysed casein and aspartic acid remained constant, showing that the nutritional effects were due to the amino-acids themselves and not to ammonia that might be liberated by their decomposition. The later experiments, in which the plants were grown with their roots in sterilised nutrient solution or sand and their upper parts in the air, have shown that aspartic acid is a very good nutrient for legumes, but not for *Gramineæ*, and that asparagin is excellent for barley, but much less good for *Leguminosæ*.

The manner in which the plants utilise such organic compounds can at present only be conjectured. On one hand, it may be that enzymes like urease, asparaginase or aspartase liberate ammonia from these organic compounds when they are still in the root system, and that the plants utilise this ammonia to synthesise protein. On the other hand, it is also possible that the amino-acids may be utilised directly for the synthesis of protein.

Enzymes: A Discovery and its Consequences

By Dr. E. F. Armstrong, F.R.S.

It is a hundred years since Payen and Persoz discovered diastase and recognised it as a ferment. To-day the ferments, or enzymes as we have preferred to call them, are in the forefront of interest as the factors concerned in all those chemical changes in the cell which in their totality are termed vital changes: they may indeed compose those invisible genes which make up the chromosomes. The discovery of diastase, apart from its broader consequences, has had a far-reaching effect also in introducing science into one of the oldest industries, one already established on the Nile in the days of the Egyptians, that of brewing: the determination of diastatic power is to-day one of the first exercises which is performed on the new season's crop of barley and malt. The studies on diastase made in the cause of brewing have in turn enriched chemical science, and there is a notable list of eminent brewers' chemists to inscribe on the roll of honour of enzyme pioneers.

The discovery of Payen and Persoz in 1833 followed an observation by Kirchhoff that germinating barley grains contained a principle capable of converting starch into sugar, a power which Leuchs discovered was also possessed by human saliva. Payen and Persoz found out how to extract ground germinating barley with water and, after filtration, precipitate a white flocculent material by means of alcohol, which when dried and redissolved turned starch into sugar. Their procedure was that which is followed to-day in extracting an enzyme, though our hands have gained not a little cunning in concentrating the enzyme and freeing it from this and that impurity, largely as the result of methods devised and elaborated by Richard Willstätter, who was Davy medallist of the Royal Society in 1932. The active material was named 'diastase' by its discoverers. It was found by them to be present in other cereals during germination, and during the 'seventies, numerous workers established that diastase is very generally present in vegetable cells so long as the latter are living. In the meantime, Miahle had made a diastase by adding alcohol to saliva, and other observers found it in the animal pancreas. Animal diastase is generally referred to as ptyalin in the literature and in many textbooks the term amylase is preferred to diastase; a proper sense of historical loyalty should, however, make us adhere to the older term.

In any mention of the diastase story, the work of Horace Brown and Morris in connexion with the translocation of starch comes immediately to mind. The formation of diastase in foliage leaves during darkness and its conspicuous diminution during bright sunshine, were discovered by them and used to explain the behaviour of starch, which varies in amount in the opposite sense during the twenty-four hours. Classical also are the studies of Cornelius O'Sullivan at Burton-on-Trent of the action of malt diastase on starch, published in 1876: they mark a beginning of the efforts to establish the kinetics of enzyme reactions and also to unravel the structure of starch itself.

We are still working at this problem—starch—nearly sixty years later, without any certainty that the goal is in sight, though the work of Haworth is definitely carrying us forward: it is successful perhaps because he is taking nothing for granted and is insisting on the need of relying only on the evidence furnished by quantitative laboratory work. The newer branches of chemistry, X-ray analysis and colloid conceptions, have been called in to help establish the size and form of the starch molecule, but the results obtained with their aid are definitely of a more speculative character.

Many have toiled, others may be said to have toyed, with the kinetics of enzyme action, but the chief result has been to introduce confusion into what at bottom is simple, once the disturbing factors have been eliminated. We would rather write of diastase in relation to starch from the point of view that the enzyme itself must be a composite material. The evidence is becoming more precise that the maltose units in starch are not all joined together in the same manner and that there are perhaps two different and separable diastases, which act differently upon starch, one producing the α-form of maltose, the other the β-form.

Starch is the largest item in our dietary, it is the most common reserve material of plants, in the industrial arts it has a thousand and one uses, it is the basis of beer, its study forms the most intriguing chapter of vital chemistry. Is it not remarkable that there is still more that is obscure than is definite in our knowledge of the structure of its molecule and its microscopic and macroscopic make-up?

Following the discovery of diastase, other enzymes attacking substances other than starch have been found in both plants and animals. Studying the behaviour of first one and then another of these, it has become possible to establish their general properties, in particular their high degree of specificity, the ease with which their activity is destroyed or modified by chemical or physical alteration. They have very many properties of the living unit, except the all-essential one—they are incapable of self-duplication. The enzyme particles are non-resolvable under the microscope. Jerome Alexander has emphasised their resemb'ance to the self-reproducing ultramicroscopic genes of which the chromosomes are thought to contain immense numbers, and there are adherents for the idea that the genes may be regarded as enzyme-like catalysts, capable of self-duplication, which dominate by their catalytic control of chemical changes what is to happen in their neighbourhood. They are capable both of self-duplication and of initiating and controlling each and every chemical reaction in the cell, the only proviso being that the necessary raw materials for the catalysed reactions are provided in the milieu and that the supply of the raw materials and the removal of the products of metabolism proceed at suitable rates of speed. Each gene may be supposed to catalyse one reaction only and its catalyst to be composed of a single molecule; in practice, there will always be large groups or strings of genes. Our methods of isolating and purifying or concentrating enzymes, after the breakdown and killing of the cell, aim at the selection of the catalyst derived from a single gene: it will be obvious how Utopian this quest must be.

The great majority of enzymes act, like diastase, as catalysts of hydrolysis; that is to say, the elements of water enter into the reaction, which indeed commonly takes place in the presence of an excess of water. The amount of water in the cell, its relative abundance in a free and active state, unattached to or uncombined with other substances, is an extremely important, if not the determining, factor in governing the direction and position of the final equilibrium, for it is in the highest degree probable that the same catalyst which favours hydrolysis can also, under other conditions, accelerate the reverse change, that of synthesis. The factors which control the activity of a cell are the catalyst, a supply of raw materials and the presence of more or less active water. When there is excess of water the reactions are those of hydrolysis; when there is a scarcity of water and the cell sap is concentrated or saturated, which is another way of expressing that the water molecules are all occupied, the reactions are those of synthesis.

There is now a consensus of opinion that enzymes consist largely of organic matter made up of at least two units, the carrier, forming a large colloid particle, and the other, the active substance, which is held or oriented in an efficient position and stabilised by the carrier. Without the carrier the catalyst cannot function, and consequently, when the process of purification leads to a disruption of the carrier, the catalyst loses its activity. Such a statement is to some extent incompatible with the possibility of isolating a definite crystalline enzyme, as Northrup claims to have done for pepsin and trypsin; more enlightenment is obviously required on this point before a final opinion can be pronounced.

The enzyme study began with Payen and Persoz; its first century of endeavour may be said to have ended with the anniversary address of Sir Frederick Gowland Hopkins to the Royal Society last November, wherein he summarises the present conception of an enzyme and emphasises the importance of the conviction which is now general amongst biologists that modern chemical methods, starting with isolated reactions made with tissue extracts and passing to studies of other tissue extracts in which the progress of a variety of reactions is studied, do in fact give a picture of the reactions which are taking place in intact or still living tissues or cells. In his words, we have escaped from the dilemma voiced in earlier dogma, that since chemical methods convert the living into the dead, they can do nothing to elucidate the dynamic events of life.

Such is the progress of the century. Since the discovery of the first enzyme we have travelled far to form a conception of an enzyme as an active spot of specific configuration at part of the surface of the colloid particle. Progress has been slow, largely because chemists and biologists have not been ready for such a conception and all that its application involves. Now at the beginning of the second century of enzyme study, things are different; the authoritative summary by the president of the Royal Society in closing the old period serves to open the new at a moment when the army of research workers is ready to apply it.

Obituary

PROF. C. CORRENS

THE death on February 15 of Prof. Carl Correns at the age of sixty-eight years leaves a gap in the ranks of those who were prominent in the Mendelian investigations from their inception in 1900. Much of his work was in the more obscure and difficult fields of plant genetics, such as self-sterility, variegation and the inheritance of sex. He brought a wide knowledge of plants and a broad biological outlook to bear on these and other problems, and will always be held in remembrance as one of the three co-discoverers of Mendel's principle of segregation in hybrids.

When Hugo de Vries published his paper "Sur la loi de disjunction des hybrides" in the *Comptes rendus* of the Paris Academy of Sciences in March 1900, announcing the re-discovery of Mendelism, based on the study of eleven different species, Correns was stimulated to write immediately, as he says, a paper for the *Berichte der deutschen botanischen Gesellschaft*, which was entitled "G. Mendel's Regel über das Verhalten der Nachkommenschaft der Rassenbastarde", in which he showed how he had independently arrived at the same conclusions as de Vries through experiments with maize and peas. He, like de Vries, at first thought his results and conclusions were new, and then found Mendel's paper of 1866 with similar results and the same explanation of them, namely, the principle of genetic segregation. In the previous year he had published an explanation of the phenomena of xenia in maize and in 1901 he wrote another extensive and classical paper on this subject.

Correns was thus a leading spirit in the rediscovery of Mendel's laws and in a clear statement of the mode of sex determinations in diœcious and polygamous flowering plants. Important investigations on the latter subject were published in 1907, in which the Mendelian conceptions were applied to the inheritance and determination of sex in plants. This was the period when active discoveries of the sex chromosomes in insects were taking place, and in 1913 he published in collaboration with Goldschmidt a general work on what we would now call the genetics of sex. Several other investigations of sex in plants appeared during the next decade, *Melandrium, Silene* and *Rumex* being among the forms mainly studied.

Many of Correns's researches were fundamental and he preferred to labour in fields that were off the beaten track. The number of plant genera with which he worked at different periods was a surprisingly large one. In a series of papers on *Mirabilis* hybrids, beginning in 1902, he showed that when the yellow and white varieties are crossed, the F_1 is rose-coloured with red stripes while the F_2 produces no less than eleven colour types. This was important at a time when it seemed that Mendel's law of dominance might be as fundamental as his law of segregation. The influence on the offspring of the number of pollen grains placed on the stigma was also investigated in *Mirabilis*, and several interspecific hybrids of *Matthiola incana, M. glabra* and other species were analysed. Other genera the genetics of which he studied included *Urtica, Trinia, Hyoscyamus, Dimorphotheca, Lamium, Veronica* (long and short style), *Linum* and *Fagopyrum*.

Correns was interested in the rôle of the cytoplasm in inheritance and published an important paper on this subject in 1909. He studied variegation and its inheritance, finding cases where the development of the chloroplasts was under nuclear control and therefore Mendelian in inheritance, while in other cases the control was cytoplasmic. His paper at the Berlin Congress of Genetics in 1927, of which he was a vice-president, was a masterly summary of knowledge regarding non-Mendelian inheritance in plants and animals, but he was prevented by illness from giving it in person.

So early as 1889, Correns made a study of pollen germination and the pollen tubes of *Primula acaulis*, and much later he showed in *Melandrium*, by placing a few pollen grains on the stigma, that the upper ovules of the flower are generally fertilised first.

Darwin's experiments on self-sterility led him to the view that in such cases each plant, although self-sterile, can be fertilised by pollen from any other plant. This hypothesis of individual stuffs was held until the work of Correns on *Cardamine pratensis* in 1912, in which he found that the offspring of two crossed plants fell into four interfertile groups, and the inheritance of self-sterility could be explained on a Mendelian basis. This conception has since been confirmed and extended in other genera. In 1928, however, Correns found that in *Tolmiea Menziesii* the individuals from a cross were fully fertile with each other, as Darwin had supposed, and it is possible that in this species the determination of the stuffs inhibiting pollen tube growth is not genotypic but phenotypic.

Correns was born in Munich on September 19, 1864, his father being a painter and a member of the Bavarian Academy of Art. In 1892 he went to Tübingen and in 1899 was made an extraordinary professor in that University. He went from there to Leipzig in 1902, and in 1909 became professor of botany at Münster in Westphalia. It was there that I first met him, in 1910. An animated discussion with him in the streets of Münster, surrounded by curious onlookers, made one feel rather like one of the disputants in a university town in the Middle Ages. With his bright red hair, thick glasses and large hands with extremely long nails trimmed to a point, he was a man of extraordinary appearance in his younger days. When the Kaiser Wilhelm Institute for Biological Research was founded at Berlin in 1914 he was called to be its first director and was also made an honorary professor in the University of Berlin. His connexion with this research institute was maintained to the end, its extensive garden, greenhouses and laboratories being the scene of all his later work. An early work, published in 1899, had to do with vegetative multiplication in the mosses, but nearly all his later investigations had some bearing on genetics.

In 1924, on the occasion of his sixtieth birthday, Correns's collected works on plant genetics, numbering sixty papers, were published in a volume of some 1,300 pages. He married a niece of Nägeli and published (1905) Mendel's letters to Nägeli, in which an unsuccessful attempt was made by Mendel to interest Nägeli in his views regarding the phenomena of heredity. They were republished as an appendix to the volume of collected works.

Correns may be said to occupy a somewhat similar place in modern plant genetics to that of Kölreuter in the eighteenth century. His results were always clearly and methodically presented. He held several honorary degrees, was a member of the Prussian Academy of Sciences, and in 1931 was elected a foreign member of the Linnean Society of London. R. RUGGLES GATES.

WE regret to announce the following deaths:

Prof. C. W. Cook, professor of economic geology in the University of Michigan, known for his work on oil geology, on February 17, aged fifty years.

Prof. Erik G. Odelstierna, professor of the metallurgy of iron in the Technical High School, Stockholm, from 1904 until 1918, aged seventy-nine years.

News and Views

Education and Economic Recovery

IN his chancellor's address to the University of New Zealand, Dr. J. Macmillan Brown emphasised the contribution of education to recovery from the periodic economic and financial depressions in the assistance it gives to the growing mind to understand the methods and efforts of the past. Youth must be trained to know the data of the situation before it is stirred to investigate and learn the full terms of the problem before attempting its solution. Accordingly, education, and especially advanced education, should be the last element in a civilised community to be submitted to the axe of economy in meeting the want and suffering associated with a depression, and the pruning of educational resources in New Zealand and elsewhere is a definite setback to recovery. The two essentials in the recovery of a community from depression are the broadening and deepening of the intelligence of the mass so as to enable them to learn the lesson of thrift and foresight, and highly developed leaders capable of seeing far into the darkness of the future and leading their fellows to the highest practical goal. The selection and training of the intellectual leaders is the more important for advance in research, and a large proportion of exceptional material is left undeveloped in the absence of scholarships to select and carry it through its course.

IT is the true function of a university, Dr. Macmillan Brown said, to select the research workers and leaders of thought who will save mankind from these recurrent dilemmas. Universities and institutions which prepare for them are the main means by which the methods of one generation are stored up and improved for the benefit of subsequent generations. Dr. Macmillan Brown pointed out that more and more widely is it being realised that self-isolation of the individual, the caste, the community, and the nation is suicidal,and destructive of progress, and he urged that the transmission of advance from one community and one generation to others can only be effective, beyond such institutions as the British Commonwealth of Nations and the League of Nations, if there is fellowship and effective international co-operation between the universities. With the universities and their graduates forming the constituencies in every nation and community, mankind might make some approach to a world parliament or at least to a conference which would be competent to indicate sanely the conditions that should belong to a federation of the world. Dr. Macmillan Brown concluded his plea for the place of a trained intelligence in the direction of the affairs of mankind by pointing out that university education must be built on broader foundations than narrow specialisation and be capable of selecting the wisest, most developed minds and characters the community can produce.

Roman Richborough

AFTER eleven years excavation on the site of Roman Richborough, it is at last possible, according to the account of the most recent discovered given by

Dr. J. P. Bushe-Fox before the Society of Antiquaries on April 6, to assign a purpose to the large timbered buildings occupied during the first half century of the Roman conquest of Britain. It is now evident that these buildings, differing in character from both barracks and structures for domestic occupation, were port store-houses for grain and other material. The outlines of rotted beams, piles and foundation trenches, indicate that they were erected in rectangular blocks or *insulæ*, each comprising four buildings. Of these, one faced the main road and the other three lay behind, with approaches from the side roads which bounded the *insulæ*. Each building was provided with a loading platform, while that facing the road had also a space in front in which carts might draw up. This building was erected on a massive beam platform, embedded in the soil, to take heavy weights; but the remaining three were erected on piles to give the ventilation necessary to protect corn against the effects of damp. No other granaries such as these are known. Another building, also unique in character, lies on the other side of the road. It is a rectangular structure erected around a court. Each side consists of two rows of rooms, ranged in pairs. It is conjectured that these were the quarters of the police guarding the stores. Dr. Bushe-Fox describes the whole base camp as an unprecedented discovery. His account of the arrangements for unloading and storing material had an almost disconcertingly modern note.

Completion of the Grid in Great Britain

THE fifth annual report of the Central Electricity Board, which has just been published, is of special interest as it is the last of the reports marking the construction of the grid in Great Britain. It has only taken six years to complete instead of the estimated eight years. The cost is less than 27 million pounds and is within 2½ per cent of the original estimate of the Electricity Commissioners, a very satisfactory result considering the work has been so accelerated. In future, the main business of the Central Board will be in connexion with grid trading. The main function of the grid is to see that there is an abundant supply of electrical energy at each central station so that the engineers will have more time to devote to the increase of their sales. The report shows that continuous expansion is taking place in outlying areas supplied by secondary transmission lines. The Weir Committee thought that it would be best that most of the secondary transmission should be carried out by the distributing authorities, but the Central Board found it best to regard these lines as part of the grid and so help the distributors. Successful researches have been made on methods of cheapening the cost of tapping the grid. This is a step towards supplying sparsely populated districts with electric light and power and thus encourages rural development. Instead of a tapping costing £20,000, it is hoped to reduce it to £4,000. It was feared at one time that difficulty would be obtained in getting wayleaves, but out of twenty-one thousand wayleaves obtained, less than six hundred (2·83 per cent) had to be acquired compulsorily.

The French Grid

THE new electric transmission line which has just been opened between the Massif Central and Paris will greatly facilitate the supply of electrical energy in France. The station on the River Truyère, a tributary of the Garonne, is one of the largest and finest hydro-electric stations in Europe. We learn from the *Electrician* of March 24 that the pressure is 220 kilovolts; this compares with 132 k.v., the pressure used on the British grid. The line starts from Rueynes, passes by Marèges, Eguzon and Chagny and ends at Chevilly, which is south of Paris. At present, the line can carry 100,000 kw. When the new Sarrians station is completed in a few months' time, the power transmitted will be doubled by means of a second line which is under construction. The first part of the 220 k.v. line was constructed by the Paris-Orleans Railway in order to safeguard its supply for traction purposes. It was first operated at 150 k.v., but this was modified a year ago by the addition of supplementary insulators to the strings of insulators then in use. This enables it to work at 220 k.v. Luckily, the three overhead conductors had been placed 7·8 metres apart initially, so the conversion was easily effected. The average span between the lattice towers is 250 metres and the lines are of steel-cored aluminium. The distributing stations for the Paris region are supplied by three underground lines with energy at 60,000 volts. Provision has been made so that five more of these lines can be laid when required. The important falls of the Massif Central are now connected with Paris. The joining up of the stations at the falls in the Alps and on the Rhine with the falls of the Massif Central is a most satisfactory engineering achievement.

Sir Ambrose Fleming on Television

THE fourth Exhibition of Television and Photo-Electric Apparatus was opened at the Imperial College of Science, London, S.W.7, by Sir Ambrose Fleming on April 5. In the course of his remarks, Sir Ambrose said that the invention of television has gone through the usual three stages. First, when everyone thought it could not be done at all. Second, when leading experts declared that even if it could be done, it was no possible use, and third, when the wiseacres said, we knew it could be done, but it is not a commercial proposition. "It has been my good fortune to be closely and practically connected with the introduction into great Britain of three important inventions, namely, the telephone, the incandescent electric lamp and wireless telegraphy, and I have seen these three stages illustrated in them all. Television by Baird's system is now a practical achievement and capable of being of real entertainment value, as those know who have seen the nightly demonstrations of it by a good receiver. Our great grievance at present is the impossible hour at which the B.B.C. broadcast it, namely, 11-11.30 p.m." There is need for a careful scientific study of the subjects that can be 'televised'. Television is a new art and has new principles connected with it. The substantial facts on which it is based are well known and the keen amateur is doing not a little to push it forward. This exhibition showed how much has been done in this respect, and also how much is being done by great corporations with large resources.

IT is, however, necessary that the ideas of the public on television should not be turned in the wrong direction by exaggerated or imaginary statements as to its real and possible achievements, because then only disappointment results when the true facts are known. "We cannot yet televise directly a cricket match at Lords or a Cup football contest at the Crystal Palace. But what we can do is to take on a moving film with a camera certain not very quickly moving objects of large size and televise this film. There is an immense field in this respect for educational work. The Latin poet Horace told us, what every advertiser knows well, namely, that memory of the eye is more tenacious than memory through the ear. We can televise geometrical diagrams, lessons in botany, physics, and zoology, and countless other useful visions. Let us hope that this new weapon science has provided will not be vulgarised or put to base uses, but employed for the instruction, elevation and national entertainment of the public at large."

Eugenics and Marriage Laws

IN a note contributed to the *Bulletin of Hygiene* for February, Lettin M. Crump discusses the introduction of pre-marital health certificates from the point of view of eugenics. In Mexico, impediments to marriage include insanity, and similar restrictions extending to imbecility or feeblemindedness are found in certain of the United States. The growing practice of requiring a certificate from a qualified medical practitioner for insurance purposes, as well as from candidates for public appointments, seems likely to undermine opposition on this score, and with a more enlightened public opinion the need for compulsion would be greatly lessened. In some countries, notably Austria, Germany and some of the United States, the establishment of centres for giving advice on all matters concerning marriage has found favour. Useful advice can only be given when the investigator has a knowledge of the applicant's physical and mental condition as well as of his hereditary background and that of his proposed partner, the type of inheritance of any heritable disease or defect which may be present in the pedigree and of the effect which other causes may have upon the appearance of such heritable conditions. Mendelism provides us with a growing body of available information concerning inheritance in man, and evidence collected in the working of marriage advice bureaux leads to the conclusion that feeblemindedness is in many cases inherited and usually behaves as a recessive; the mating of possible heterozygotes is undoubtedly to be discouraged. Although evidence collected from pedigrees is frequently both vague and faulty, justice demands that every available means of making public such information as exists should be fully used so as to enable the conscientious citizen to avoid handing on defects from generation to generation.

Anthropological Teaching and Research in Australia

THE passing of a resolution by the Australian and New Zealand Association for the Advancement of Science at its meeting at Sydney in August last, urging upon the Government the need for anthropological training for all white people who hold positions of authority or control over natives, has moved Prof. Raymond Firth to open the new volume of *Oceania* (vol. 3, pt. 1) with a survey of the progress of anthropology in Australia in the period 1926–32. The choice of this period as the limit of his survey is determined by the fact that its beginning coincides with the setting up of a Department of Anthropology in the University of Sydney and the appointment of Prof. A. Radcliffe-Brown to the chair, as the result of a resolution passed at the Australian meeting of the Pan-Pacific Congress in 1923. At the same time, a comprehensive scheme of research was initiated under the direction of the Committee for Anthropological Research of the Australian National Research Council, for which funds have been generously provided by the Rockefeller Foundation. In what has been accomplished, much has been due to Prof. Radcliffe-Brown, who, in virtue of his position in the University of Sydney and on the Research Council, has acted as a link in bringing closely together teaching and research. Investigation has been directed to both human biology and social anthropology. Not only has the work of Spencer and Gillen in central and northern Australia been continued and extended, but Prof. Radcliffe-Brown and others have also conducted investigations in areas in the east and the west of the continent. In looking forward, Prof. Firth sees that much virgin soil has to be explored, not only in Australia, but also in New Guinea and Melanesia; but in the first-named, he points out, there is need for haste lest the material vanish.

Racial Distributions in Palæolithic Europe

IN some 'notes' contributed to the *Proceedings of the Prehistoric Society of East Anglia* (vol. 7, pt. 1) Mr. M. C. Burkitt offers some interesting suggestions as to the possibly dual origin of the races and cultures of palæolithic age in Europe. He points out that it is no longer possible to accept the unfailing regularity of the sequence of cultures as originally classified by the French archæologists, and points to the contemporary existence, as proved by the fossil fauna, of a core industry, the *coup de poing* of Chelleo-Acheulean times, on the west bank of the Rhine and of flake industries on the east bank, the two intermingling on the border line in eastern France, in southern Belgium and in Britain as seen in the Levallois and Clactonian industries. He goes on to point out that, while the *coup de poing* does not occur east of the Rhine with a few exceptions, the flake industry can be traced, except for certain gaps, from east of the Rhine right across Europe and Asia to China, where perhaps it finds its prototype in the flake implements of Peking man. This, to his mind, suggests a dual origin for the races of early palæolithic Europe, one branch coming from Africa where the *coup de poing* occurs with some frequency, and the second bringing the flake industry from Asia. He applies the same argument to Aurignacian man, pointing out that while the female statuette of upper palæolithic date has never been found in Africa, it occurs in Russia and examples have recently been found so far east as Maltá in Siberia. As the African affinities of Aurignacian man, or rather of his culture are not to be questioned, Europe would again in this period represent the point of confluence of two streams of migration.

Prof. A. Stoll's Researches in Biochemistry

THE biochemists in Germany publish their results in the *Biochemische Zeitschrift*, and some ten thousand original papers have been published in it in the past twenty-six years. The American and British work has been even more fruitful, at least in quality, during this period, so that there is little wonder that we are beginning to make progress in unravelling both the nature and structure of the substances found in the living cell and in understanding something of the reactions which take place there. Prof. Arthur Stoll of Basel has recently put together, for the purpose of a lecture, his own experiences since 1909 in developing some sections of biochemistry ("Ein Gang durch biochemische Forschungsarbeiten", pp. 41+5 plates. Berlin: Julius Springer, 1933. 3 gold marks), much as in another walk of life a traveller might do on his return from a lengthy journey. Stoll began research with Willstätter and the chlorophyll molecule, and he returns to it at the end of his journey, for it has not yet given up all its secrets. In the meantime he has concerned himself with ergot, with scillarin, and with the digitalis glycosides. His pamphlet, which is illustrated, makes attractive reading: we concern ourselves too much nowadays with the abstruse intricacies of our sciences, and would be well advised to view them occasionally from a wider angle.

Reopening Limestone Oil Wells with Acid

THE natural flow of an oil well may recede either from the exhaustion of the oil supply or as the result of a stoppage of the pores of the oil-bearing rock cutting off the free supply of oil. In the past, somewhat drastic methods have been tried to overcome this drawback, but they are difficult to carry out, especially at a depth which may be half a mile below the surface. When the well is in a limestone formation, it has now been discovered that it is possible to open it up again by treatment with successive quantities of 10 or 15 per cent hydrochloric acid, which dissolve new channels in the calcareous rock and permit of a new flow of oil. The use of hydrochloric acid is only made possible by the addition to it of 1–5 per cent of an arsenic compound, which inhibits the action of the acid on the metallic casing and pump tubes of the well. Other inhibitors, including certain organic nitrogen bases, have been discovered but the arsenic compounds are the most convenient to apply in practice. The discovery has been made by the Dow Chemical Co. in partnership with the Pure Oil Co., and patented as the Dowell process: it is described in greater detail in the News Edition of *Industrial and Engineering Chemistry* for February 20. The use of acid made inactive towards metal surfaces is a novel and important one: it may be a revolutionary factor in oil production. Further, it is likely to be beneficial in natural gas production and in other directions. It is certainly an achievement to be able to control the action of a strong acid as a boring agent half a mile below the surface.

Petroleum Production in Russia

ACCORDING to Science Service of Washington, D.C., the petroleum production of Soviet Russia has now attained the position of being the second largest in the world, the estimated yield last year being 150 million barrels. Many factors have conduced to this remarkable advance, but chiefly the confiscation of oil property and its operation under Government directorship without competition have been responsible. The fields have the additional advantage that they are well situated for transport of oil to foreign markets and they are also easy to develop and operate. Another factor in the situation is the results of exploratory work, which have indicated the existence of potential oilfields along a tract of country stretching from the Arctic Ocean to the Caspian Sea. From the point of view of economics, as emphasised by Mr. R. C. Beckstrom to the American Institute of Mining and Metallurgical Engineers recently, Russia's home consumption is based mainly on industrial development and particularly on the extensive use of tractors for agricultural purposes, while external markets for oil lie chiefly with Italy, France and England, to which more than forty million barrels were exported last year. If the ambitious goal of more than 480 million barrels of oil production for 1937 is realised by the Soviet authorities, then clearly the whole scheme of international stability, in so far as petroleum supplies are concerned, will receive a severe shock.

Institution of Heating and Ventilating Engineers

THE Institution of Heating and Ventilating Engineers of 12, Russell Square, W.C.1, now issues a *Journal*, the first number of which was published in March. The object of the *Journal* is to keep its members in touch with the latest practice both at home and abroad and in particular to give them the latest results of the research work being done on the subject. In the first issue, an important paper by E. Herring is published giving the methods that have been employed for warming and ventilating the Masonic Peace Memorial building in Great Queen Street, London, W.C.2. As many masonic meetings will be held there, it was necessary to use special precautions so as to eliminate the possibility of sound being transmitted from one room to another. All the fans, motors, and machinery had to run silently and it was necessary that the rate of ventilation and the temperature of each room should be controlled from the engineer's room, so as to obviate the necessity of the engineering staff having to enter any 'lodge' room. The 'lodge' rooms are designed to give a maximum supply of conditioned fresh air equivalent to 1,750 cub. ft. a head an hour. A refrigerating plant is installed for cooling and removing the moisture from the air when necessary. In winter, hot water is supplied by steam-heated storage calorifiers but in summer, owing to the small demand, an electrical thermal storage system is employed. Steam for all purposes is generated by four steam boilers working at a pressure of 100 lb. per sq. in. and capable of evaporating 7,000 lb. of water an hour at 212° F. Storage for the oil fuel is provided by five cylinders having an aggregate capacity of sixty tons.

Research at the Dove Marine Laboratory, Cullercoats

THE Report of the Dove Marine Laboratory, Cullercoats, Northumberland, for the year ending June 30, 1932, has recently been published. The research during the year dealt chiefly with herring investigations, work on pollution, conditioned responses in fishes and hydrographical records. Large numbers of young herrings with three winter rings were present in the East Anglian October shoals. A new year class, that of 1928, has appeared in the winter shoals about the north of Scotland. It was not present in the samples from north-west Ireland. Mr. Storrow's work includes notes on organisms coming with the Atlantic waters during the last few years, the abnormal flow in all probability influencing the herring fishery, especially in the Clyde. His conclusions from the age composition of the Northumberland herring shoals are that the data support the idea of a gradual change in the fishing rather than change due to recent oceanic activity. Prof. Meek's work, with the help of Miss Benton, on *Sagitta*, shows that *Sagitta setosa* may be an important indicator of currents. Dr. Bull's researches on fish behaviour have been helped greatly by the erection of a partially sound-insulated and entirely separate building. Conditioning experiments involving the stimulus of small temperature increments and changes of direction of current flow are in progress and positive results have been obtained. In his work on the study of colour vision by the technique of differential inhibition, Dr. Bull has shown that the common shanny, *Blennius pholis*, has a wide range in wave-length discrimination, being able to distinguish one colour from another in many instances.

Coco-nut Palm Products

COCO-NUT oil derived from copra is by far the most important ultimate product of the coco-nut palm, and the future prospects of the industry are reviewed in a volume under this title, which appears as the second volume of a "Survey of Oil Seeds and Vegetable Oils" (London: H.M. Stationery Office, 2*s.* net). Within the last ten years there has been an increase of about thirty per cent in the world acreage under coco-nuts, bringing the total to 7,000,000 acres in 1931. Since 1921 the British Empire has accounted for slightly more than half this amount. The increase in production has been mainly due to the demand from the United States, but the needs of that country can be met by the production from the Philippines. Other producing countries, including those of the British Empire, must be chiefly dependent upon European consumption. Owing to the heavy production of whale oil, however, there is at present no sign of an increased demand in the European market. In this market the demand for coco-nut oil depends upon the expansion of the soap and margarine industries. The survey concludes that the output of copra will be on the increase for several years and that the bulk of this will appear on the world market, although local consumption accounts for a considerable proportion of the output of most producing countries, especially of India, the Dutch East Indies, and the South Sea Islands.

Science Museum Handbook of Pumping Machinery

THE recently issued handbook to the collection of pumping machinery at the Science Museum (H.M. Stationery Office, 2*s.* 6*d.* net) prepared by Mr. G. F. Westcott, should be of widespread interest. It is not a catalogue to the exhibits but a general introduction to the development of pumps illustrated by drawings and photographs of actual plant or models. The ground it covers extends from the earliest baling appliances to the most recent molecular vacuum pumps. After a general review of what may be called the philosophy of pumping, there are four sections dealing in turn with pumps for liquids, pumps for gases, high vacuum pumps and multiple purpose pumps. There are thirty plates in all, including a reproduction of the Museum chart illustrating the development of pumping machinery. This ingeniously worked-out chart might prove useful in many technical schools. One illustration of great historical interest is that of the famous pumping plant erected at Marly by order of Louis XIV for supplying water from the Seine to the fountains at Versailles. With its fourteen water-wheels, its 253 pumps and its connecting mechanism, it was probably the largest machine ever erected. Its effective horse power, however, was very small and it is said that the King of Denmark once remarked to Louis that his water cost him as much as his wine.

Death Valley a new 'National Monument'

ON February 11, by presidential proclamation, President Hoover gave the status of 'national monument' to Death Valley, famous in the history of California for the hardships endured by pioneer trains crossing its arid, salt-crusted waste (Science Service, Washington, D.C.). A national monument differs from a national park only in respect to grade of protection; administration is simpler, either because of difficulty of access, lack of funds to provide full national park administration, or other reasons. The area of the new monument is 1,601,800 acres, about two-thirds of the total land in the Valley, and its dryness is so great that mineral salts of several varieties form thick crusts upon the surface of the soil. Of these, the borax deposits used to be worked commercially. In spite of its dryness, Death Valley is by no means barren; more than 500 kinds of plants live there and on these subsist many animal species. Some of the notable natural features are Telescope Peak, Furnace Creek, a green valley despite its name, and Ubehebe Crater.

Engineering Research in Japan

THE National Research Council of Japan (Imperial Academy House, Ueno Park, Tokyo) publishes a series of journals or reports each of which deals with some branch of science. Of these, vol. 8 of the *Japanese Journal of Engineering* has recently reached us. This consists of a book of 90 pages containing abstracts of 313 papers read before various scientific and technical societies or contributed to periodicals in 1928. The abstracts are grouped under civil engineering, mechanical engineering, naval architecture, aeronautics, electrical engineering, mine engineering and metallurgy. Though the papers themselves are written in Japanese, the abstracts are in English and for the greater part have been written by the authors of the papers. In general, the subjects dealt with follow the lines of engineering research in other countries, and the volume shows that Japanese engineers have a keen appreciation of the value of original investigation.

Awards of the Royal Geographical Society

HIS MAJESTY THE KING has approved the award of the Royal medals of the Royal Geographical Society as follows: Founder's medal, to Mr. J. M. Wordie, for the work he has done in polar exploration from the voyage of the *Endurance* in the Weddell Sea in 1914–17 to the present day; Patron's medal, to Prof. Erich von Drygalski, for his researches in glaciology both in the arctic and the antarctic regions. The Council has awarded the Murchison grant to Dr. Noel Humphreys, for his expeditions in Ruwenzori; the Back grant to Miss Freya Stark, for her journeys in Luristan; the Cuthbert Peek grant to Dr. L. S. B. Leakey, for his studies on climatic changes in East Africa; and the Gill memorial to Khan Sahib Afraz Gul Khan, of the Survey of India, for his frontier and trans-frontier explorations and surveys.

Announcements

MR. M. T. DAWE, director of agriculture, Cyprus, has been appointed by the Secretary of State for the Colonies to be director of agriculture and forests, Palestine.

THE Gesellschaft Deutscher Naturforscher und Aerzte will not meet this year. The next meeting, the ninety-third, is to be in Hannover in 1934. Local secretaries are: Prof. C. Müller and Prof. Dr. Willige, both of the Technische Hochschule, Hanover.

AT the meeting of the London Mathematical Society on April 27 at 5 p.m. at Burlington House, Prof. B. L. van der Waerden, of the University of Leipzig, will deliver a lecture on "Hypercomplex Numbers". Members of other scientific societies who may be interested are invited to attend.

ARRANGEMENTS are being completed for the holding of the 1933 meeting of the Canadian Phytopathological Society at Regina, Sask., in July, in conjunction with the World's Grain Fair and the C.S.T.A. Convention. A committee under the chairmanship of Dr. P. M. Simmonds, Saskatoon, has been appointed to look after local arrangements. The secretary of the Association is T. G. Major, Central Experimental Farm, Ottawa.

THE papers read at the conference on "Protein Swelling and Allied Phenomena" held at the Leathersellers Hall, E.C.2, on December 1, are being reprinted in book form, including the introductory address by Prof. F. G. Donnan. The book is of about 124 pages, and copies will be shortly obtainable from the Offices of the International Society of Leather Trades Chemists at 17, Market Street, London, S.E.1; price 5*s*. 6*d*., including postage.

THE Quekett Microscopical Club has arranged a series of demonstrations in connexion with microscopy, which are being given on the same evenings as the ordinary fortnightly meetings for the next three months. The meetings are held in the rooms of the Medical Society of London, 11, Chandos Street, Cavendish Square, W.1. Tickets for the meetings can be obtained from Mr. Milton Offord, 8, Culmington Road, West Ealing, W.13. A brochure containing lists of recent additions to the library, cabinets and collections of instruments, of the Club has recently been published, price 1*s*. Further information regarding the Club can be obtained from the secretary, Mr. W. S. Warton, 35, Doneraile Street, S.W.6.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An organising mistress for domestic subjects in the North Riding of Yorkshire—The Secretary, Education Offices, County Hall, Northallerton (April 25). A chief engineer and manager of the Government Electrical Undertakings, Ceylon—The Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1 (April 28). A principal of the City of Leeds Training College—The Director of Education, Education Department, Leeds (April 29). A demonstrator in the Department of Zoology at the Bedford College for Women, Regent's Park, N.W.1 (April 29). A Grade 1 engineering assistant at the Mines Department—The Under-Secretary for Mines, Establishment Branch, Mines Department, Cromwell House, Dean Stanley Street, S.W.1 (May 1). A probationary assistant naval constructor of the Royal Corps of Naval Constructors—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (May 1). A headmaster of the Nautical School and School of Fishermen, Boulevard—The Director of Education, Education Offices, Guildhall, Hull (May 6). A professor of education at the University of Leeds—The Registrar. A junior full-time teacher in the Department of Engineering of the Municipal Technical College, Oldham—The Director of Education, Education Offices, Oldham. An assistant instructor in the School of Navigation at University College, Southampton—The Registrar.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Phenomenal Regression to the Real Object

DR. THOULESS's interesting article in NATURE of February 25 on this subject is of special interest at the present time when physicists, physiologists, and psychologists are co-operating in the solution of problems regarding vision. The terminology and modes of expression are not unusually quite different in the respective branches of investigation, and this makes it very imperative that there should be full mutual discussion regarding the statements involved so as to avoid the possibility of misunderstanding.

The following remarks may err through misunderstanding on my part of Dr. Thouless's exact meaning. But it seems to me that his statement that Fechner's law (expressed in the form $E = k\log(R/R_0)$) implies that there is a single sensation intensity for every stimulus strength may be misinterpreted as to its implications. Clearly, for example, if R_0 is constant while R is a stimulus of variable magnitude but constant quality, the statement holds. But it has to be remembered that the three variables in terms of which, as a minimum, R is usually expressed, may also appear in R_0; and that R_0 is usually dependent also on many other variables. Examples of these are the time which has elapsed since the stimulus began, or the times which have elapsed since preceding stimuli began or ended, or the qualities of these stimuli, or the physiological condition of the observer as dependent on precedent exercise, bodily or mental, and so on. It is evident that, unless these extraneous variables are kept constant, one and the same sensation will not in general result from a definite external stimulus.

Recognition of these conditions has direct application to the interesting cases discussed by Dr. Thouless in which the presence or absence of an additional datum, such as the distance of an object, has influence on the result of the given stimuli. But it is then a matter for experiment to determine the form of the function of that additional datum which, being introduced into the threshold value R_0, will include the more general results within the scope of Fechner's law for single-valued sensation.

This raises the question of whether or not subjective, as well as objective, data should be treated similarly in so far as that may be found possible. The influences of memory, expectation, bias of any type, and so on, have to be eliminated or allowed for as new qualitative or quantitative data. Further, since external action produces mental activity, may not independent mental activity give rise to alteration of these mental activities ? Physical analogies suggest this as a possibility. The scope for investigation on these lines is immense, but its results may not of necessity lie outside the field expressed by Fechner's law.

The interesting results which are indicated in Dr. Thouless's diagram seem to be perhaps in part due to the actual conditions of projection. If the inclined circle be viewed from a sufficiently near point, a marked excess of the apparent short diameter over its normal projection actually exists ; and the curve is not an ellipse. But no rough method of measurement gives an accurate test, while an indirect *guessed* measurement is very liable to error.

W. PEDDIE.

Department of Physics,
University College,
Dundee.
March 2.

I AGREE with Prof. Peddie that the Fechner relationship need not necessarily involve a single sensation strength for every stimulus strength, but that implication is strongly suggested by the habitual statement, as the fundamental law of sensation strength, of a law which expresses this strength as a function of one variable (stimulus strength) and not of three or more. The attitude of mind induced by Fechner's law has certainly been the relative neglect of the effects of spatial and temporal contrast (treating those as mere disturbing factors) and the complete neglect of the effect of the total situation under complex conditions of perception. This seems to be sufficient justification for making Fechner's law the starting point of a description of a quantitative investigation of the effects of the total situation.

I certainly agree that any such variable may affect the absolute threshold in such a way that E remains the same function of R/R_0. I know of no investigation to prove that this is the case. I do not think that the question is important, since the formula $E = k\log(R/R_0)$ is indefensible even for uniform contrast conditions, since it assumes the validity of Weber's law for stimulus values down to the threshold value, which is found experimentally not to be even approximately correct.

Prof. Peddie's last paragraph is based on a misapprehension. If an inclined circle is observed from a near point the short axis of the projected figure will certainly be relatively longer than it would be if the observation were made from an infinite distance when the projected axis-ratio would be equal to $\sin\theta$ (if θ is the angle of inclination of the disc to the line of vision). The error resulting from this miscalculation of the projected axis-ratio would have been small but I did not make this mistake. Nor did I use a rough method of measurement. The only rough measurement I mentioned in my article was for the demonstration of the presence of the effect (not the exact measurement of it) by means of an elongated ellipse. Since the effect is large, it is easily perceptible to rough demonstration. Where, however, quantitative results were required, the measurements and calculations were as accurate as I could make them.

ROBERT H. THOULESS.

Department of Psychology,
University, Glasgow.

Photosensitised Decomposition of Ozone by Chlorine

THE decomposition of ozone, photosensitised by chlorine, has been the subject of numerous investigations, and it would appear from recent work that the kinetics of this reaction are by no means so simple as at first supposed. In particular, the recent paper of Heidt, Kistiakowsky and Forbes[1] describes a complex dark reaction which occurs simultaneously with the photosensitised decomposition. We have read this paper with great interest, since we have also been engaged in an investigation of this reaction, and whilst our results confirm those contained in this paper, we are unable to agree with the authors' interpretation of them.

We have found that, with pressures of ozone and chlorine above 100 mm. (and light of 365mμ) a red liquid oxide of chlorine separates on the walls of the vessel. The ratio $Cl_2 : O_3$ determined by the method of Schumacher and Stieger[2] agrees closely with the formula $(ClO_3)_n$.

The oxide is presumably to be identified with the mist noted by Allmand and Spinks[3] and by Heidt, Kistiakowsky and Forbes[1]; the former authors note the formation of chloric and perchloric acids, when the mist dissolves in water. As is well known, a similar red oxide, Cl_2O_6, was also described by Bowen[4], by Bodenstein, Harteck and Padelt[5], and by Schumacher and Stieger[2] as formed by the interaction of chlorine dioxide and ozone.

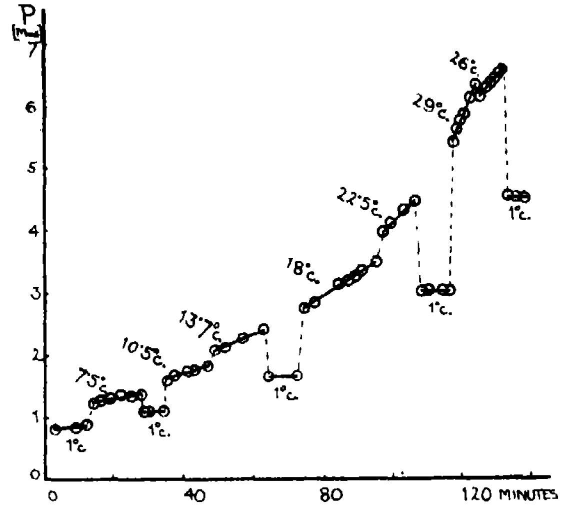

FIG. 1.

It was found that the separation of this oxide was particularly marked at 0° C. A quantity of the oxide was prepared at 0° C. and the excess chlorine, ozone, and oxygen removed by a Hyvac pump while the vessel was cooled to − 10° C.

On warming the oxide it was then found that no constant vapour pressure was shown. On the contrary, a steady increase of pressure occurred, this being negligible at 1°C. and becoming more and more rapid as the temperature rose. On cooling again to 1°C., the original pressure was not regained, showing that an irreversible decomposition had occurred (Fig. 1).

We suggest that the phenomena noted by Heidt, Kistiakowsky and Forbes are explicable in terms of the separation of this oxide, which, according to our experiments, should have occurred under the conditions adopted by them, namely, high chlorine and ozone pressures and an initial temperature of 2°C.

The continued increase of pressure after the light was cut off noted by them, indicates the (thermal) decomposition of this oxide film; it is to be noted that, according to their experiments, this did not occur until after the gases had been illuminated for a considerable period, as is to be expected, according to this hypothesis.

We find a temperature coefficient of 2·34 per 10° C. for the decomposition of the oxide; this is of the same order as that noted by Heidt, Kistiakowsky and Forbes for their "dark reaction". Our apparatus is essentially similar to that used by them, and on account of the separation of the oxide we have not attempted to measure quantum efficiencies at chlorine pressures above 100 mm., since it is impossible to do so by pressure increase. Our results at lower pressures of ozone and chlorine indicate, on the other hand, that reproducible results are obtained when separation of the oxide is not allowed to occur, and that, while inert gases have no effect on the course of the reaction, oxygen had a distinct inhibiting effect. These results will shortly be published elsewhere.

R. G. W. NORRISH.
G. H. J. NEVILLE.

Department of Physical Chemistry,
Cambridge.
Feb. 21.

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[1] *J. Amer. Chem. Soc.*, **55**, 223; 1933.
[2] *Z. Anorg. Chem.*, **184**, 272; 1929.
[3] *J. Chem. Soc.*, 599; 1932.
[4] *J. Chem. Soc.*, **123**, 2328; 1923.
[5] *Z. Anorg. Chem.*, **147**, 233; 1925.

Electrometer Triode in the X-ray Ionisation Spectrometer

MR. J. A. C. TEEGAN, writing in NATURE of February 25, mentions that the application of the electrometer triode to X-ray ionisation spectrometers is under consideration. I have successfully used this valve for this purpose during the past three years and saw it in use in Germany even earlier.

In the earlier measurements in this laboratory, the grid of the valve was not connected to the filament through a high resistance. X-rays were allowed to pass into the ionisation chamber for a suitable interval, generally 10 sec., and the charge collected on the insulated electrode was measured by the change in anode current of the electrometer triode. This is usually of the order of one microampere and may be measured directly by a galvanometer. This is the most sensitive method of using the valve.

Following Dr. B. W. Robinson, of the Davy-Faraday Laboratory, it is now the practice here to connect the grid to the filament by a high-resistance leak (pencil line on amber) in which case the steady deflection of the galvanometer measures the ionisation current. The anode current when no X-rays are entering the chamber is compensated by a potentiometer arrangement and the circuit is essentially the same as that given in the diagram of Mr. Teegan's letter.

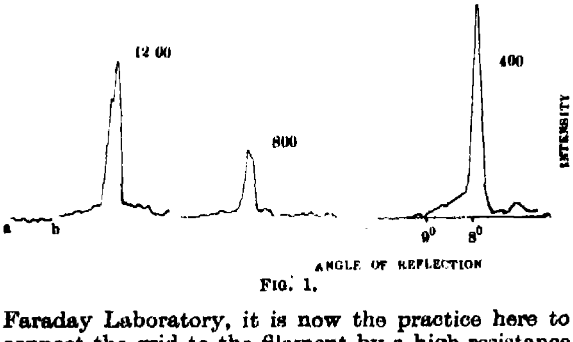

FIG. 1.

For most measurements a semi-automatic recording device is used. The ionisation chamber is set at the required angle and the crystal rotated through the reflecting angle by means of a worm-driven wheel.

The same driver causes a drum carrying paper to pass under a pen which is moved by hand along guides parallel to the axis of the drum so that it follows the deflection of the galvanometer spot. The curves in Fig. 1 were obtained in this way: the ordinates, being the deflections of the galvanometer, measure the intensity of the reflected X-rays and the abscissæ give the rotation of the crystal.

The curves were obtained by passing molybdenum $K\alpha$ radiation, filtered through zirconium metal, through a thin plate of gypsum so that orders (400), (800), (1200) could reflect at angles of 8°, 16°, 24° approximately. The crystal turns through 1° in 1·6 minutes and this corresponds to the paper moving forward by 2·8 cm. This enables measurements to be made much more quickly than was possible with the earlier arrangement. The steadiness of the zero is indicated by the line *ab*, which was obtained with the X-rays cut off, and the sensitivity may be estimated from the fact that the X-rays used for the curves shown produced a barely visible fluorescence in a darkened room on a barium platinocyanide screen.

The apparatus is simple to set up and very reliable. Precautions must be taken to shield the valve electrostatically but the galvanometer need not be so protected. The total cost of the apparatus is less than that of the usual electrometer systems used for the same purpose.

W. A. Wooster.

Department of Mineralogy and Petrology,
Cambridge.
Feb. 25.

In Nature of February 25, Mr. J. A. C. Teegan proposed to apply the 'electrometer valve' now produced commercially by the G.E.C. to an X-ray ionisation spectrometer for the amplification of ionisation currents. It may interest him to know that such a valve has been in use for this purpose in this Laboratory for the past eighteen months with success, using a circuit identical in all essentials with that which he describes.

The G.E.C. valve is simpler in construction than the FP 54 pliotron described some years ago by Messrs. Metcalf and Thompson for a similar purpose in the *Physical Review*; I think, however, that it is not quite so sensitive as the American valve.

To take full advantage of the G.E.C. valve used with an ionisation spectrometer, the indicating galvanometer should have a quick period (1 sec.) and sensitivity of the order of 100 divisions per microampere. I do not know whether such a galvanometer can be obtained cheaply; one can be made quite easily, since high resistance in the galvanometer coils (25,000 ohms) is of no particular disadvantage in this circuit.

B. W. Robinson.

Davy-Faraday Laboratory,
Royal Institution,
London.
Feb. 27.

High-Frequency Electric Discharge in Gases

In October 1929, while using a radio-frequency oscillator of the tuned-plate/tuned-grid type (Fig. 1) for exciting the capacitive electrodeless discharge photographed by J. and W. Taylor[1] in gases at low pressure, I observed phenomena which have not, I believe, been elsewhere described.

The frequency employed ranged from 11·1 megacycles sec.^{-1} to 21·4 megacycles sec.^{-1}; the valve was a power-oscillator of the *VO* 150 type with 1,800 volts anode potential supplied by accumulators, and the anode current ranged from 150 milliamperes to 160 milliamperes at these frequencies respectively. The anode inductance comprised three to four turns of 12 gauge wire, and to excite the discharge two wires were attached by clips to turns at opposite ends of the coil and their other ends were tightly bound round the ends of an ordinary positive column tube of about 18 cm. cylindrical length by 1·3 cm. internal diameter filled with neon with but slight traces of unknown admixture at approximately 8·0 mm. mercury pressure. The cylindrical sheath electrodes fused into the frusta-conical bulbs at the ends of the tube (Fig. 2) were not connected.

Originally, excitation of luminosity by the method used by Prof. R. W. Wood and A. L. Loomis[2] was in view, but in certain conditions, discharges were obtained of a curious nature: when the plate and grid circuits of the oscillator were closely in tune, a single streamer ran longitudinally through the tube, but instead of being straight and lying approximately along the axis of the tube, the streamer appeared bent somewhat into the shape of an elongated sine-wave of one complete cycle. When the frequency to which the grid circuit was tuned was slowly caused to diverge from that of the anode circuit, the streamer began to rotate at an accelerating rate about the axis of the tube, the sense of rotation depending upon the direction of divergence. At the same time, the streamer took on a helical conformation of one turn. With increasing divergence the speed of rotation increased until the whole tube appeared filled with glowing gas; with further divergence the discharge resolved itself into two inter-twined helical streamers revolving together but in the opposite sense to that of the single streamer. As the divergence continued to increase the angular velocity of the inter-twined streamers decreased to zero (Fig. 2), reversed and increased again until the tube was filled with a blur of light, and this cycle of phases was repeated with the periodic intercalation of an additional strand to the multiple streamer up to sixteen or seventeen strands, when they became difficult to count.

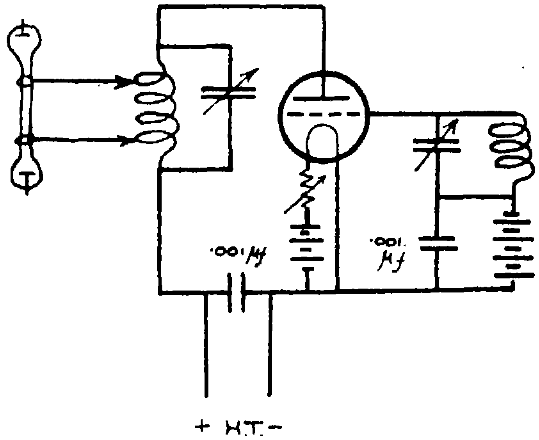

Fig 1.

This discharge was exceedingly difficult to produce at will: usually the form was that shown in Fig. 3, in J. and W. Taylor's article, but by breaking and making the anode supply circuit many times in succession, rotary streamers generally appeared. The distance between the capacitive electrodes was immaterial to inception and appearance, and orientation of the tube with respect to the coil or to a permanent magnet appeared to be without sensible effect. Once started, the discharge was extremely stable, and the envelope temperature was of the order of 40°–50° C.

Occasionally, only about half the distance between the external electrodes would exhibit rotary streamers while the remainder would contain a stationary, co-axial, thicker column (Fig. 3). A rotary discharge also occurred more frequently between the bright rings immediately within the capacitive electrodes and the unconnected sheath electrodes in the bulbs, always with a large number of strands (Fig. 4).

In explanation, I tentatively suggest that the electronic displacement current and the corresponding equivalent accelerating potential difference between two points in the gas (between which the displacement current is drifting) are out of phase to an extent depending upon the divergence of natural frequencies of tuned-grid and tuned-anode circuits of the oscillator, and the result is that an electron if it were originally at rest within the tube would describe, in the absence of collisions, a zig-zag path round an annulus inside the walls; the net effect of a large number of electrons doing this gives in general a rotary helical locus of maximum electronic velocity (and therefore of ionisations-by-collision). The suggested effect of phase difference, though a purely *ad hoc* supposition, would appear to be substantiated to a certain extent by equations (7) and (8) given by Darrow in a recent paper on "High Frequency Phenomena in Gases"[3].

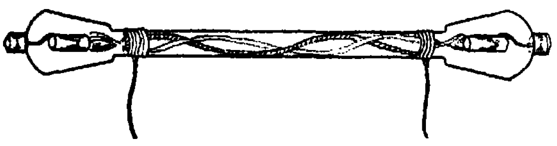

FIG. 2.

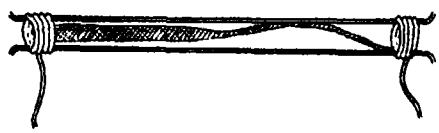

FIG. 3.

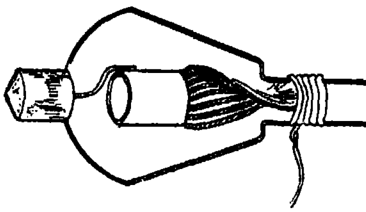

FIG. 4.

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133 Long Acre,
W.C.2.

J. C. WILSON.

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[1] *Exp. Wireless and Wireless Eng.*, 5, 60, 508; 1928.
[2] NATURE, 120, 510, Oct. 8, 1927.
[3] *B.S.T.J.*, 11, 4, 584: 1932.

Hydraulic Seismographs

PROF. KAPITZA has described[1] a balance for the measurement of magnetisation in which he makes use of hydraulic magnification and damping in a very ingenious manner and suggests that the same method may be adopted for the construction of seismographs. In order to explore the possibilities of this type of instrument for the recording of earthquakes a series of comprehensive experiments was carried out by us in the Colaba Observatory.

The apparatus for the recording of the vertical component consists of an inverted cylindrical cup, its lower horizontal face being closed by a thin metal diaphragm and a narrow open tube being attached horizontally fitting a hole in the side in which a mirror is suspended from a horizontal axle. A cylindrical jacket covers the cup all round except the diaphragm at the bottom. A highly viscous oil is then poured into the double chambers, so as to fill up completely the inner chamber, and the diaphragm is then loaded by attaching a weight of 1 kgm. or more to a rod fixed at its centre. The vertical component of the ground movements sets up oscillations in the diaphragm and forces the oil to move to and fro through the narrow tube, and this gives a large oscillatory angular motion to the mirror which is recorded photographically. With a tin diaphragm of thickness 0·019 cm. and diameter 15 cm. loaded with 1 kgm., a period of 2·3 sec. and a damping ratio of 5 : 1 were obtained when the instrument was filled with castor oil.

The low free period of the system does not make the instrument very sensitive to earthquake waves. It is, however, highly sensitive to artificial vibrations of the ground and gives also good records of the sustained vibrations, such as microseisms. Being a compact and fully assembled portable instrument it should form a valuable equipment for geophysical prospecting.

If the chambers be so arranged that the membrane is in the vertical plane and is loaded with two symmetrical weights fixed at both ends of a horizontal rod passing through its centre, the instrument records the horizontal component of the ground movements. The sensitiveness to earthquakes of the instruments for horizontal and vertical components is increased if the free period of the system is increased by using membranes of very large diameters. A leather or rubber membrane slightly increases the sensitiveness, but generally produces an unstable 'zero'. A detailed account of the investigation will be published in due course.

S. K. BANERJI.
K. N. SOHONI.

India Meteorological Department,
Poona.
Feb. 20.

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[1] *Proc. Roy. Soc.*, A, 131, 224-242; 1931.

Reversal of Current in Rectifier Photo-Cells

WE have noted with interest Mr. Guild's observations on this effect, as recorded in NATURE of March 4. In reply to his query, the values given for the relative sensitivities were for an "equal energy spectrum", being obtained by direct comparison with a Moll vacuum thermopile for the different spectrum regions. Any other method of presentation would obviously be valueless, as the energy flux reaching the cell increased rapidly with the wave-length. The maximum reverse current obtained from the marginal regions of the cell was no less than 28·5 per cent of the maximum direct current obtained for the same regions.

We should like to take this opportunity of apologising to Dr. P. Auger and M. C. Lapicque for having overlooked the section of their paper[1] in which they briefly mention the reversal phenomenon, and give its explanation, identical with the one since given by us and by Mr. Guild. Dr. Auger also studied the spectral transparency of such gold and silver films, as Mr. Guild is now doing; from this he deduced the true variation in the spectrum of the photo-electric properties of cuprous oxide, since the curves given by gold and silver film cells were identical when corrected for the transmission of the film. The transmission of cuprous oxide films has been studied by L. Dubar[2], who investigated also the temperature coefficient of the cells up to 60° C. Dubar[3] has also studied the peculiar constitution of the cuprous oxide layer.

H. H. Poole.

Royal Dublin Society.

W. R. G. Atkins.

Marine Biological Laboratory,
Plymouth.
March 11.

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[1] *C. R. Acad. Sci. Paris*, **193**, 320; 1931.
[2] *Loc. cit.*, **193**, 659; 1931.
[3] *Loc. cit.*, **194**, 1332; 1932.

A Rule for the Rotatory Direction of the Acetylated Aldonic Nitriles

During research on some sugar derivatives, the rotation in chloroform of their acetylated aldonic nitriles was determined, and the following results were obtained:

tetra-acetyl *d*-xylonic nitrile,	$(\alpha)_D^{22} = +50{\cdot}3°$;
tetra-acetyl *l*-arabonic nitrile,	$(\alpha)_D^{22} = +\ 4{\cdot}2°$;
penta-acetyl *d*-galactonic nitrile,	$(\alpha)_D^{22} = +48{\cdot}4°$.

From a search in the literature, the rotations determined for other nitriles were found to be:

penta-acetyl *d*-gluconic nitrile[1,2], $(\alpha)_D^{22} = +46{\cdot}2°; +48{\cdot}0°$;
hexa-acetyl *d*-gluco-α-heptonic nitrile[4], $(\alpha)_D^{22} = +24{\cdot}6°$;
hexa-acetyl *d*-manno-α-heptonic nitrile[3] $(\alpha)_D^{20} = +31{\cdot}4°$;
penta-acetyl *d*-mannonic nitrile[2], $(\alpha)_D^{20} = -\ 1{\cdot}4°$;
penta-acetyl *l*-rhamno-α-hexonic nitrile[3], $(\alpha)_D^{20} = -76{\cdot}4°$.

The following data were found for non-acetylated aldonic nitriles:

gluconic nitrile[4]	$(\alpha)_D^{22} = +\ 8{\cdot}8°$;
d-manno-α-heptonic nitrile[3],	$(\alpha)_D^{20} = +23{\cdot}1°$;
l-rhamno-α-hexonic nitrile[3],	$(\alpha)_D^{20} = -23{\cdot}4°$.

When the figures and signs of rotation of the acetylated nitriles are compared, it is seen that a new rule similar to the well-known amide or phenylhydrazide rules of Hudson for aldonic acids, can also be formulated for the acetylated nitriles of the same acids.

When the configuration of the 2-carbon atom is considered, it follows that nitriles in which that atom has the configuration $\mathrm{H\overset{|}{\underset{|}{C}}O.COCH_3}$ (that is, $\mathrm{H\overset{|}{\underset{|}{C}}OH}$ in the primitive monose, employing Fischer's projection formula) rotates to the right, as is found in *d*-xylonic, *l*-arabonic, *d*-galactonic, *d*-gluconic, *d*-gluco-α-heptonic, and *d*-manno-α-heptonic acetylated nitriles.

When the configuration of the 2-carbon atom is reversed: $\mathrm{CH_3CO.O\overset{|}{\underset{|}{C}}H}$ (that is, $\mathrm{HO\overset{|}{\underset{|}{C}}H}$ in the primitive monose) the nitriles rotate to the left, as in *d*-mannonic, and *l*-rhamno-α-hexonic acetylated nitriles. It follows that the sign of rotation of the nitriles will be the same as that of the amides and phenylhydrazines of the same acids. It is of no use, however, to make comparisons between the rotatory values of the acetylated nitriles and the amides or the free acids, owing to the different solvents employed in each case.

The theoretical foundations of the nitrile rule are the same as those for the amides or the phenylhydrazides, and have been explained by Kuhn and Freudenberg. Only exaltation of the individual asymmetric carbon atoms must happen owing to acetylation of the alcoholic hydroxyls. When the free nitriles are considered, it is seen that perhaps the rule can also be applied to them, although the examples are few in number.

Work is now being done with other members of the same group to see if they accord, as we expect, to the rule. It is hoped to include some α-oxy acids.

Instituto de Fisiología, Venancio Deulofeu.
Buenos Aires.
Jan. 16.

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[1] Zemplen and Kiss, *Ber.*, **60**, 165; 1927.
[2] Wolfrom and Thompson, *J. Amer. Chem. Soc.*, **53**, 622; 1931.
[3] Mikšić, *Chem. Zentr.*, 1, 2704; 1928. *Chem. Abs.*, **23**, 2941; 1929.
[4] Zemplen, *Ber.* **60**, 171; 1927.

Zones of Apparent Inhibition of Sunspots on the Solar Disc

In a recent paper[1] referred to in Nature of February 18, p. 245, Mr. P. R. Chidambara Aiyar reports the result of an analysis of the distribution over the visible portion of the sun of sunspots lasting two days, and finds that his curves of distribution show, in addition to a maximum at the centre of the disc, maxima at longitudes about 15° inside either limb. This he describes in terms of the intervening minima by calling their positions zones of apparent inhibition of spots.

It is to be expected that the number of spots of any given size or period observed, in an assigned number of degrees of longitude, would show a steady diminution from centre to limb simply on account of foreshortening rendering the spots less visible. The minima noted by Mr. Aiyar can scarcely have a physical significance since the co-ordinates used (apparent longitude on the solar disc) have no physical meaning for the sun, being fixed on any day by the position of the earth in its orbit on that day.

Mr. Aiyar has established that his results are not due to random variations in the data, and accordingly a cause lying in the mode of selection of the data is to be sought. I wish to point out that the explanation of the inhibitory zones is to be found in the following reason for the existence of the maxima near the limb, and that there is in fact no region of scarcity, but merely a spurious region of richness.

In selecting the spots, only those are used which are observed on two days, but not on three or more. If the whole surface of the sun were visible this selection would operate uniformly in all solar longitudes, but in fact only the region from − 90° to + 90° is visible at any one time, and this leads to an excessive count near the limb. Owing to the rotation of the sun, a spot travels about 15° per day, so that all spots between longitudes − 60° and + 60° are observable during two days or more; hence all spots occurring in this region are excluded from the count if their life exceeds two days, while spots in the remaining regions are observable for two days *or less*. Taking − 90° as the limb of the sun which is rotating towards the earth, all spots classified as two day spots between about − 90° and − 60° may in fact have had any life up to about 16 days, and similarly all spots classified as two day spots between about + 60° and + 90° may have a life of from two days up to about 16 days, that is, in either zone half a revolution period of the sun plus rather more than two days. Actually the limits 60° and 90° must be replaced by somewhat smaller values to allow for the loss of spots by foreshortening, and in any event the foreshortening conquers at the limb where the number must finally fall off.

Thus we are to expect spurious maxima at about ± 75° due to this selection, and this is precisely where Mr. Aiyar finds his extra maxima.

A more detailed numerical investigation will be described later.

J. A. Carroll.

The University,
Aberdeen.
March 8.

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[1] *Mon. Not. R.A.S.*, 93, 150; 1932.

Further Light on the Schneider Mediumship

I have read the review in Nature of April 8 of Mr. Harry Price's "An Account of some Further Experiments with Rudi Schneider". To deal in detail with the charge of fraud brought by Mr. Price against Schneider in his report would take up more space than could be afforded in these columns. I have, however, been closely associated with all the experiments which have been made with this medium in England (April 1929 to December 1932), and I would ask all who are interested in these matters to withhold their judgment until a report has been published of further experiments held with this medium (October to December 1932). These further experiments were carried out in as scientific and impartial a manner as circumstances permitted and the results supplied strong indications that Schneider indeed possesses genuine 'supernormal faculties'.

In reply to the suggestion put forward in the review in question that the presence of a supposed accomplice invalidates Dr. E. Osty's report "Les Pouvoirs Inconnus de l'Esprit sur la Matière"—a report of careful experiments with the same medium, 1930–1931—it appears that the attempts of trickery in question were of a puerile order and in no way affected the main issue. The infra-red ray apparatus and objects subjected to telekinesis were completely separated from the medium and sitters by a clamped gauze net, 5 feet 6 inches high, and none of the attempts at trickery affected any phenomena on the far side of the net. Out of a total of ninety séances held by Dr. Osty, the suspect attended only fifteen, of which seven were blank and at none was telekinesis reported.

It should be noted that Mr. Price did not notify his Council or any of his invited sitters of (1) the existence of the incriminating photograph, (2) the friendly warning of Dr. Osty with regard to the suspect who, however, was allowed by Mr. Price to attend all the séances arranged by him.

It is hoped to carry out still further experiments with the same medium later this year, when various improvements will be adopted concerning both the technique of the séances and the scientific apparatus employed.

C. M. Hope.

26a North Audley Street,
London, W.1.

Tracheal and Blood Gills in Aquatic Insect Larvæ

Among the larvæ of aquatic insects, two fairly well-defined types of gill-like structures are commonly found—'tracheal gills' and 'blood gills'. The former term is applied to thin plates or filaments with a copious tracheal supply and only a very small blood cavity, structures which are typically developed in such insects as Ephemeroptera and Trichoptera. The term 'blood gill' is restricted to organs which have a spacious lumen but in which tracheæ are poorly developed or totally absent; the ventral and anal gills of *Chironomus* being a familiar example. The work of Fox[1] on *Chironomus* gave rise to doubt as to the respiratory function of blood gills in general, doubt which has been strengthened by the confirmatory work of Harnisch[2], and in a recent series of papers Wigglesworth[3] describes experiments upon the anal gills* of the larva of the yellow-fever mosquito (*Aedes* (*Stegomyia*) *argentatus*), from which he concludes that the main function of these structures is the absorption of water and that they are of little value as organs of respiration. Since in this species they are much larger than in the majority of allied forms, it is probably safe to assume that in the Culicidæ as a whole, anal gills are of little importance from the point of view of respiration: a conclusion which is confirmed by my own experiments on *Culex* spp.

In view of these results, it seems opportune to give a brief summary of experiments on blood gills and tracheal gills in other aquatic larvæ which I have carried out, a preliminary account of which is already in the press[4]. The technique employed was similar to that described in a previous paper[5]. In the case of the rectal blood gills of Trichoptera, it was not possible to detect any respiratory function, and similar results were obtained with the rectal gills of *Simulium*, *Corethra*, etc. One can therefore state that in *no* case has it been shown that the blood gills of aquatic larvæ serve any useful function in respiration. While there remains the possibility that these structures may come into play only within certain limits of oxygen tension, it may be said that the work of Harnisch gives no support to this hypothesis even in that form (*Chironomus*) in which it would appear most probable.

As might be expected, experiments with tracheal gills have yielded different results and have shown that these organs are undoubtedly active in respiration. But it has long been known that the larvæ of Agrionid dragon-flies can survive for a considerable period in the absence of caudal lamellæ and Cuenot[6] showed that the tracheal gills of certain Ephemeroptera (*Ephemera*, *Chloeon*) can be removed without causing the death of the insect. In the Agrionids, the existence of general cutaneous respiration is easily demonstrated and my observations have shown that cutaneous respiration is also very prevalent among Ephemeroptera (*Chloeon*), Trichoptera (*Limnophilus*, *Anabolia*, *Leptocera*), Coleoptera (*Gyrinus*) and Neuroptera (*Sialis*), although in every case the tracheal gills are undoubtedly acting more or less efficiently. Since these observations were made, it has been shown[7] that the gills of the Ephemerid *Hexagenia recurvata* are not essential to life in the winter months and that[8] even the elaborate gills of the Caddis *Macronema zebratum* are superfluous: the insect being capable of completing its life history without them.

In certain genera of Plecoptera tracheal gills are poorly developed and in some instances, by no means small forms, they are lacking altogether, so that gaseous exchange takes place entirely through the general body surface. Experiments with larvæ of a species of *Leuctra* which lacks tracheal gills entirely showed that respiration proceeds most rapidly at the ventral surface of the thorax and the bases of the legs, the indicators being affected later at the 'neck' and at the anterior region of the abdomen. In view of this, it is interesting to note that an American species of *Nemoura* has been described[9] as having the walls of the femora richly supplied with tracheæ as if to serve as a gill.

Tracheal gills are rare among dipterous larvæ. Such gills with a large tracheal supply occur in Tipulids (for example, *Pedicia*) and in the curious larvæ of the Pantophthalmidæ, but in each case open spiracles are present, and although the gills have been shown[10] to be the site of very rapid gas exchange compared to the rest of the body, it is known[11] that the larva (*Pedicia*) cannot long survive occlusion of the spiracles. They are at best a rather unimportant accessory means of respiration.

To sum up, it can be said that the blood gills found in aquatic insect larvæ are practically negligible so far as respiration is concerned, and to this extent the conclusions of Wigglesworth are supported. Certain types of tracheal gills, on the other hand, may be very efficient. But they are by no means the sole organs of respiration and even where highly developed, may be secondary in importance to the general body surface; under experimental conditions the animal can often do without them for long periods if not altogether.

W. H. Thorpe.

Zoological Laboratory,
Cambridge.
Feb. 20.

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[*] Owing to their small tracheal supply and relatively large blood space the anal gills of mosquito larvæ are here classed as 'blood gills' rather than 'tracheal gills'.

[1] Fox, H. M., *J. Gen. Physiol.*, **3**, 565; 1920.

[2] Harnisch, O., *Z. Vergl. Physiol.*, **11**, 285; 1930.

[3] Wigglesworth, V. B., *J. Exp. Biol.*, **10**, 1, 16, 27; 1933.

[4] Thorpe, W. H., Proc. IV Int. Congress Entom. Paris (in press); 1933.

[5] Thorpe, W. H., *Proc. Roy. Soc.*, B, **109**, 450; 1932.

[6] Cuenot, "L'Adaptation", Paris; 1925.

[7] Morgan and Grierson, *Physiol. Zool.*, **5**, 230; 1932.

[8] Morgan and O'Neill, *Physiol. Zool.*, **4**, 361; 1931.

[9] Wu, C. F., Bull. Lloyd Library, 1923.

[10] Thorpe, W. H., In press (1933).

[11] Oldham, J. N., *Proc. Roy. Phys. Soc.*, **21**, 33; 1926.

Earthquakes in the Holy Land: A Correction

In an article on earthquakes in the Holy Land[1] there is given a list of 207 shocks, of which there is record, between the years 1606 b.c. and a.d. 1927. Among these are 27 dates from an Arabian authority, As-Soyuti, whose work appears in translation in the *Journal of the Asiatic Society of Bengal*. In transcribing those dates I failed to observe that they were stated as a.h., that is, *Anno Hejira*, instead of *Anno Domini*. They are, therefore, as quoted in my list something over six centuries too early. The corrected dates are as follows:

A.H.	A.D.	A.H.	A.D.	A.H.	A.D.
94	712	434	1042	552	1157
98	716	455	1063	565	1169
130	747	460	1067	575	1179
220	835	462	1069	578	1182
233	847	479	1086	597	1200
242	856	484	1091	600	1203
245	859	532	1137	702	1302
393	1002	538	1143	791	1388
425	1033	551	1156	889	1484

Inasmuch as the Hejira dates from July 622 a.d. and there are adjustments of the calendar dates for fractions, these figures may be off one year. It is also probable that the original dates are approximate. Hence where As-Soyuti differs by a year from others given in the list as published, one shock only is presumably meant.

In this connexion I would direct attention to a very ancient, yet definite observation regarding the now well-known earthquake fault that traverses the eastern slope of the Mount of Olives:

"And His feet shall stand . . . . upon the mount of Olives, which in that day *is* before Jerusalem on the east, and the mount of Olives shall cleave in the midst thereof toward the east and toward the west, *and there shall be* a very great valley; and half of the mountain shall remove toward the north, and half of it toward the south."[2]

Activity on this fault was the occasion of destructive tremors in 1927. That it was the scene of more obvious displacement some 2,500 years earlier we cannot doubt in view of the graphic description of the Old Testament writer, although his identity and the exact date of his prophecy are matters of uncertainty, especially with reference to this particular passage.

Bailey Willis.

Stanford University,
California.
March 6.

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[1] *Bull. Seismol. Soc. America*, **18**, 1928.

[2] Old Testament, *Zechariah*, 14, 4, 520 b.c.

A Numerical Coincidence

In "The Expanding Universe" Sir Arthur Eddington refers to the *fine-structure constant*, which appears to be a fundamental in the modern physics of which he treats, as a pure number the value of which is close to, if not exactly, 137, and in a later passage he writes: "nature's curious choice of certain numbers such as 137 in her scheme."

There is no indication that Sir Arthur includes the following facts in his thesis but it is undoubtedly the case that the number 137 is remarkable because it is the logarithm of itself, or, to be more precise, 13713 is the mantissa to five decimal places of the logarithm of 13713. Also the reciprocal of 13713 used as circular measure is the value of the usual symbol for the rate of rotation of the earth, it being the angle through which the earth turns in one second of mean solar time.

These things are mentioned as an interesting coincidence in an excellent but perhaps little known book, "A Few Chapters in Astronomy", by Claudius Kennedy, first published in 1894. The resemblance of this salient number to one in a very different connexion may well be taken as an example of Nature's whimsicality.

H. P. Hollis.

65, Tranquil Vale,
Blackheath, S.E.3.
March 13.

Research Items

Age of Maglemose in Britain. The evidence for dating the three Maglemose harpoons, which have been found in Britain, by means of the pollen deposits in peat, is discussed by H. and M. E. Godwin in *Antiquity* for March. Of the two harpoons from Holderness in Yorkshire, the Skipsea example was found below 5 ft. of peat with remains of reindeer and an *Ancylus* fauna. Samples of the peat deposit, which is 7 ft. thick with brown sandy silt below, show an immigration and rise of *Alnus* with a diminishing *Pinus*, a high initial percentage of *Corylus*, falling rapidly, but with a pronounced secondary maximum, a small percentage of *Salix* and *Tilia*, and *Ulmus* and *Quercus* showing high percentage values in the lower samples. These conditions are characteristic of the Boreal period, the actual site of discovery being late Boreal. A 'moorlog' sample trawled from the North Sea between the Leman and Ower banks off the coast of Norfolk, the point from which a Maglemose harpoon was trawled in the summer of 1932 [this should be September, 1931], showed an absence of alder, a virtual absence of elm and an absence of oak from the basal sample, and suggests that this harpoon is rather older and of early Boreal age. The attempt to obtain samples of peat from the Hornsea site in Holderness, from which the second of the Yorkshire specimens came, was unsuccessful. Turning to analogous finds on the Continent, the artefacts from Kunda in Esthonia came from a layer of 'bleke', a fresh-water calcareous deposit of the Kunda sea, overlying clay with sub-arctic plants and *Betula*, *Pinus* and *Salix*. The Kunda artefacts can be dated with certainty as of Boreal age and correlated with the *Ancylus* maximum. The *Pinus* maximum and fall, the diminishing *Betula*, the increasing *Alnus* and the immigrant *Ulmus*, with *Quercus* not yet present, characterise the Boreal period for the more northerly parts of Europe. Forest development seems to have been synchronous in Esthonia, Denmark and England and the Maglemose cultures of each were approximately contemporaneous.

Saharan Rock-Engravings. "L'Adrat Ahnet : Contribution à l'Etude archéologique d'un District Saharien" (*Tr. et Mém. de l'Institut d'Ethnologie*, Paris. T. 19) by Dr. Th. Monod contains, *inter alia*, the results of an examination of a large number of rock engravings and inscriptions. These have been recorded on thirty-six sites, of which the author has visited twenty-nine. The problem of the age of these engravings, in default of data, seems insoluble. A certain criterion of relative age is afforded by the weathering of the engraved lines ; but this ceases to be an indication when once they have toned down to the tint of the surrounding surface of the limestone. It does not seem possible to relate the engraving with certainty to the chronological and classificatory schemes suggested for the rock engravings of Northern Africa, especially as these are not themselves convincing. The only classification that appears possible is into two groups according to the subjects :—(1) a pre-camel bovidian group and (2) a camel (equine) group. Of these the first is the older and the artists might well have been the ancient agricultural black population of the Sahara, possibly neolithic ; while the second might have been exclusively Libyo-Berber and historic. The first group is characterised by a remarkable profusion of Bovidæ and by typical African fauna, elephants, giraffe, rhinoceros (?) ; but neither camel nor horse is present ; human figures are without the 'Libyan forelock' and are armed with bows and throwing-knives (?). The engravings have a dark patina. The bow, often shown on South Algerian engravings, is possibly an Ethiopian characteristic. In the second, the camel group, there are no elephants or giraffe (?), camels and horses appear, and the human figures show the 'Libyan forelock' and are armed with a round buckler, three javelins with metal tip and a sword which hangs from the buckler arm. Many show marked steatopygia. The patination is light in colour.

Distribution of Birds of the Russian Altai and north-west Mongolia. A posthumous paper by P. Sushkin has recently been published (*Bull. Soc. Nat. Moscou*, 41, Nos. 1–2) in view of the increasing trend towards mid-Siberian investigation. A description of the topography and vegetation of the area precedes a list of 373 species and sub-species of birds, tabulated according to district and the nature of their stay. Excluding occasional species, about ninety per cent of the forms are classed as 'nesting'. Conclusions are drawn as regards the division of the territory in relation to its fauna. In addition, 26 new, probably new, and imperfectly known sub-species are described in both Russian and English. The contribution gains additional importance from the fact that the author considered the list practically exhaustive for the area. It is to be regretted that lack of space made it impossible to include the entire work, with photographs, etc.

Worms parasitic in Cetacea. Dr. H. A. Baylis has compiled a useful catalogue of the parasitic worms of Cetacea ("Discovery" Reports, 6, 393–418 ; 1932). The first section of the work includes a list of the parasites, in which are given the synonyms of each species, the hosts from which they have been recorded, and references to the principal publications in which the species are described or discussed. The recorded species of trematodes are eighteen, of cestodes sixteen with three which can only be placed generically, of nematodes twenty-four besides two larval forms and one doubtful species, and of *Acanthocephala* seven species and two worms only generically determinable. The second part of the work consists of a list of hosts with the parasites recorded from each and is followed by a bibliography.

Spider Crabs from Japan. Eleven species of Japanese Oxyrhyncha belonging to ten genera are described by Dr. Tsune Sakai in the Science Reports of the Tokyo Bunrika Daigaku, Section B., No. 4, 1932 ; Zoological Institute, Tokyo University of Literature and Science ("Notes on some Rare Materials of Japanese Oxyrhyncha"). New information on some rare forms is given, two of the species are new and five are recorded for the first time from Japan. Most of them are inhabitants of Indian and tropical seas. *Halicarcinus orientalis* n.sp. is peculiarly interesting because this genus is usually found in the southern hemisphere only. The second new species, *Archæopsis rostrata*, is closely allied to *A. thomsoni* but has much broader rostral horns which are more prominent than any known species of the genus. All these crabs vary greatly and a good series of specimens was available in most of them, thus linking up the extreme forms which might have been regarded as separate species. The full-grown male of *Naxia hystrix* is described for the first time, the previous descriptions being mainly from young females. Young and adults of both sexes were abundant and showed very important differences both with regard to the sexes and in development. The carapace in the adult is globular but in the young it is longer than broad, and the rostral horns in the adult are much shorter in proportion to the carapace than they are in the young.

Hybrid Bananas. The search for a banana which is immune to Panama disease is leading to interesting results. At the Imperial College of Tropical Agriculture, Mr. E. E. Cheesman is making genetical studies of bananas, and some of the results are reported in two recent papers (*J. Genetics*, vol. 26, No. 3). As the cytological findings are of much interest, it is hoped that the fixation may be somewhat improved. Previous workers have concluded that the chromosome numbers in cultivated bananas were multiples of 8 or 4, but Mr. Cheesman finds that 11 is probably the basal number, though secondary pairing in meiosis indicates that this may have been derived from an original eight. The sterile and parthenocarpic Gros Michel banana is found to be triploid ($2n = 33$). When pollinated by a diploid variety of *Musa malaccensis* ($2n = 22$) a few seeds are formed, less than one in a hundred flowers. From such seeds ten plants were raised, eight of which were like the female parent and had $2n = 44$ chromosomes. The other two were thick-leaved, sterile dwarfs with about 75 chromosomes. One of the F_1 plants with 44 chromosomes differed from the rest in being immune to Panama disease. This plant (*I.C.*1) showed a high degree of self-incompatibility when selfed, but yielded five offspring, three of which had 44 chromosomes and two 46. Attempts to cross Gros Michel with the pollen of the immune plants yielded one seedling only, which had about 39 chromosomes. The F_1 back-crosses, however, readily with the original male parent, giving vigorous plants having 33 somatic chromosomes. The Mysore banana, which appears to be immune, and has $2n = 33$ chromosomes, was also pollinated by *M. malaccensis* and yielded more seeds. Nine F_1 hybrids were raised. Six of them resembled the female parent and had $2n = 44$ chromosomes, two were thick-leaved dwarfs like those of the Gros Michel cross, and one with $2n = 33$ was intermediate between the parents. Mysore × *I.C.*1 gave two plants, both thick-leaved. One had $2n = \pm 55$ chromosomes, and the other, a dwarf, ± 90. Several other mutant types of dwarf bananas from various sources are briefly described in *Tropical Agriculture*, vol. 10, No. 1.

Motion of a Cone at High Speeds in Air. When a body moves through air at a uniform speed greater than that of sound, it is well known that a 'shock' wave is produced which moves with the body. This wave is very characteristic of photographs of flying bullets. Taylor and Maccoll have given (*Proc. Roy. Soc.*, Feb.) a solution of the hydrodynamical equations which satisfies the condition that the flow is irrotational and that the surfaces of constant pressure, constant velocity and constant density are cones coaxial with the projectile and have the same vertex. The solution was obtained by numerical integration and was used for calculating the pressure at the surface of the cone and the shape of the shock wave. It is found that the conical regime is only possible for projectile velocities above a critical value, which is 1·46 times the velocity of sound for a 60° cone. The theory was tested by measuring the pressures at the surface of cones mounted in the high-speed wind tunnel at the National Physical Laboratory and satisfactory agreement with calculation was obtained. Photographs of flying, conically-nosed bullets were made at Woolwich which showed the breakdown of the conical regime at low speeds. At high speeds the shock wave was a true cone in contact with the vertex of the bullet, while at lower speeds the wave has a curved nose and travels ahead of the bullet.

Predictions of Nuclear Moments. Almost as soon as the neutron was discovered, it was suggested by various authors that the neutron must be a constituent of other nuclei, and it is now generally realised that the well-known difficulties with respect to the nuclear moment and statistics of nitrogen, etc., can be avoided, if the neutron be assumed to have half a quantum of angular momentum, and to obey the exclusion principle. In two recent papers in *Current Science* (Nov. 1932 and Feb. 1933), Prof. B. Venkatesachar and T. S. Subbaraya have applied this model to make more detailed predictions of nuclear moments. They assume that all the protons combine with neutrons to form α-particles, except for an odd proton if the atomic number is odd; the remaining neutrons arrange themselves in levels in the same way as the planetary electrons in an atom. The several possible values of the nuclear moment j may be written down in each case. The values of j determined from the hyperfine structure and from the band spectra are shown to be in agreement with one of the calculated values, except in a few cases.

Measurement of X-Ray Tube Current and Voltage. G. W. C. Kaye and G. E. Bell of the National Physical Laboratory read a helpful paper on the measurement of X-ray tube current and voltage to the Institution of Electrical Engineers on March 30. From the point of view of the X-ray worker, measurements of tube current and of exciting voltage are only a means to an end. They help him to form an estimate of the amount and quality of the radiation he is using. In the case of two types of commercial X-ray tubes—the Coolidge and the Metalix—they found that the output was proportional to the product of the current by the nth power of the peak voltage. In the case of unfiltered radiation from a tube with a thin window n was about unity, but for heavily filtered radiation n might be so great as five. The various types of valve rectification circuits suitable for X-ray work were discussed. It is proved that for like values of peak voltage and milliammeter readings for full-wave and half-wave rectification, the radiation outputs are the same over a pressure range from 40 to 80 kilovolts. The output for constant voltage is about 1·8 times greater. From the radiation point of view the essential factors of voltage excitation are the peak value and the form of the wave. The several methods of measuring high voltages are dealt with in detail. It is pointed out that the moving-coil ammeter customarily employed only indicates the mean current and not the maximum current through an X-ray tube excited by a pulsating voltage. It is concluded that while the moving-coil ammeter is adequate for the measurement of sustained tube currents, it is best to use some form of ballistic meter for currents lasting less than about a second.

Structure of Cellulose. One of the difficulties in correlating the physical and chemical properties of cellulose is the peculiar, almost self-contradictory, nature of this substance. Thus, the tensile strength of an artificial silk fibre may correspond weight for weight with that of a wire made from a light metal such as duralumin, although so far as transparency and conductivity of electricity and heat are concerned, cellulose has no semblance of metallic properties. A combination of X-ray and chemical methods will probably ultimately provide the explanation of these difficulties, and it is from this point of view that Prof. M. J. Duclaux describes the results of recent work on the subject in *La Papeterie* (Nos. 18 and 19; 1932). The X-ray diagrams are best explained on the assumption that the greatest length of the cellobiose molecule is equal to that of the crystal lattice (10·3 A.). This, in fact, is the foundation of the theory proposed by Mark and Meyer, namely, that the lattice takes the form of an oblique prism, and it involves the orientation of a cellobiose molecule at each corner and one joining the horizontal faces; two such molecules would then be common to each of four continuous lattices. Opposed to this is Staudinger's suggestion that the cellobiose molecules may form a long chain, and this is supported by the progressively increasing viscosity and decreasing solubility of chain complexes built up from simple molecules. One is left with the impression that the arguments in favour of each type of structure are equally potent, but that once the question of the length of the chains is settled a big step will have been taken in the direction of a solution of the problem.

Astronomical Topics

Occultation of Regulus on April 6. Extensive preparations were made to observe this occultation at stations near the northern boundary, which crossed England from Liverpool to Dover. Both in the neighbourhood of Canterbury and in that of Hitchin, parties of astronomers occupied posts about a mile apart along lines at right angles to the boundary: but clouds prevented any useful results from being obtained. The only time-observation to hand was made by Rev. O. Walkey at St. Buryan, Cornwall; long. 5° 36′ 18″ W., lat. 50° 4′ 58″ N.; in a letter to the *Morning Post* he gave the time of disappearance as $20^{h}35^{m}23^{s}$ U.T., but did not give the time of reappearance, though he stated that the star was hidden for 45^{m}, which is the maximum for any point in the British Isles. The phenomenon was seen as a spectacle from Worthing, but no times were recorded. It is worth while to remind the public that they can do useful work by timing the disappearance of stars, using the wireless time-signals to find the errors and rates of their clocks. The times must be given to seconds, and the position of the station determined from a large-scale ordnance map.

A Remarkable Short-Lived Nova. A photograph taken at Uccle by MM. Delporte and Arend on the evening of March 20 showed an image of a star of magnitude 13·2 (the first announcement gave mag. 11·0, but this was corrected to 13·2) of which no trace could be seen on earlier plates, one of which was taken in 1927, four in 1932 and one on March 18, 1933; this last showed stars to mag. 17·0. The position of the star for 1933.0 is $7^{h}18^{m}29·13^{s}$, N. 28° 38′ 1·7″. The following further observations were made at Uccle on the evenings of the dates named: March 21, mag. 13·5; March 22, mag. 14·5; March 23, mag. 17·0; on March 24 it was invisible, but the observing conditions were bad (U.A.I. Circs. 430, 431, 432). Further information is contained in Harvard Cards 264 and 265; the star was not found on Harvard plates taken on March 17 and March 22, which show stars to mag. 12; but plates taken by Prof. G. van Biesbroeck with the 24-inch reflector at Yerkes show it of mag. 14·5 on March 23·17 U.T., and of mag. 16·5 on March 24·19 U.T. The rapid rise and fall is thus confirmed. The star would seem to belong to a different category from ordinary novæ; also long-period variables generally remain at maximum for several days. The region should be scrutinised from time to time in case of a reappearance.

Report of the Director of Leyden Observatory for 1932. This report gives evidence of a large amount of valuable work carried out not only at Leyden but also at Johannesburg, at an equatorial station in Kenya, and at the Perkins Observatory in Ohio. At the latter station Dr. Oort received permission to take a number of plates of extragalactic nebulæ with the new 69-inch reflector; these are to study the surface luminosity and the distribution of light in different portions. The observers at the Perkins Observatory have promised to continue the series; the plates will be measured at Leyden. The work of Dr. Hins and Mr. van Herk in Kenya is nearly completed. Its object is to obtain fundamental declinations by observations of the azimuths of stars when they are moving vertically in the east and west. The results should be free from the uncertainty due to refraction. The time spent at the station was too short to give a complete catalogue of fundamental declinations; all that was aimed at was to give a full test to the possibilities of the method, in the hope that it may be carried out on a larger scale.

Plates for the determination of proper motions in the Pleiades continue to be taken under the direction of Prof. Hertzsprung; Mr. Uitterdijk examined the proper motion of the star 190 in the cluster N.G.C. 1647; it was suspected that this was a white dwarf accidentally superposed on the cluster, but the observations show no appreciable relative motion, so that it belongs to the cluster and is not a dwarf.

Several members of the staff went to America for last year's solar eclipse and the meeting of the International Astronomical Union at Harvard; Prof. Hertzsprung took advantage of his visit to Harvard to obtain estimates of the magnitude of variable stars from the immense series of plates that are now rendered easy of access by the new buildings erected for them. A 16-inch equatorial is being constructed for the observatory by the firm of Sir Howard Grubb, Parsons and Co. This will be erected in the grounds of the Union Observatory, Johannesburg, by kind permission of the latter, which has for many years been carrying on a scheme of joint work with Leyden.

Botany in Russia

NUMBERS 1–5 of vol. 27 of the *Bulletin of Applied Botany, of Genetics and Plant Breeding*, issued at Leningrad, 1931, under the editorship of Prof. Vavilov, director of the Institute of Applied Botany, present a most impressive picture of the vigorous research along purely scientific lines, as well as into applied problems, which is proceeding in the U.S.S.R. In all, these five numbers contain more than two thousand pages. The papers are in Russian but are generally accompanied by English abstracts, upon which the following notes are based.

In the first number, G. A. Lewitsky summarises the work carried out in the cytological laboratory of the Institute of Plant Industry in the period 1927–30. The investigations have been governed by no less ambitious an aim than the discovery of the variations undergone by the nucleus during the process of evolution. This obviously involves studies linking cytology with systematics, and the work began with the genus *Festuca*. Here it was found that the polyploid multiplication, now so well known to the cytologist, penetrated into even the last subdivisions of the genus made by the systematist. The work then spread to the karyology of the whole great family of the Gramineæ, on which a monograph by N. P. Avdulov is now being published. This work has revealed another type of chromosome variation, affecting the individual units of the haploid group. In the Gramineæ, it is concluded, the basic number of chromosomes has diminished with evolution, from 12 and 10 in primitive types to 7 and 5 in more specialised stocks; along with this has proceeded a change from the tiny dumb-bell shaped chromosomes of the Oryzeæ and Panicoideæ to the larger worm-shaped chromosomes of the Poæoideæ.

Such researches necessitated the elaboration of methods of elucidating the morphology of the chromosomes, and the present volume consists largely of papers describing the methods thus developed and the results obtained. The relation of chromosome morphology to systematic affinity is elucidated in an intensive study of the sub-family Helleboreæ. A paper is also included upon the alterations induced in the chromosome by X-rays. The whole volume describes an intensive study upon fundamental cytological problems and it is to be hoped the results may be rendered more accessible to non-Russian workers.

No. 2 contains several important papers upon cereal breeding and upon genetical studies with other economic crops; in particular, British cereal breeders will be interested in the studies of A. A. Orlov on the collection of barleys in the Institute of Plant Industry and of V. V. Suvorov on the Russian barleys. Orlov concludes that the barleys of Abyssinia and Eritrea are at the present time in a stage of an "impetuous creative process"; a re-arrangement of hereditary characters is proceeding actively and a number of new forms originating. Barleys are thus turning up which are very important from an agronomical point of view and have great biological plasticity.

Papers are also included upon the baking properties of mixtures of wheats and upon the connexion between physical and chemical characteristics of the wheat grain and the yield of flour. V. M. Kalashnikov has a paper upon breeding experiments with 'guayule' (*Parthenium argentatum* Gray) which is apparently to be tried in Russia as a home-grown source of rubber.

No. 3 contains more than 650 pages upon the forest studies and work on forest products carried out under the guidance of E. E. Kern. These studies of the possibilities of native trees and the behaviour of introduced species have naturally great interest for foresters.

No. 4 contains a more miscellaneous series of papers arising out of Russian genetical studies. T. Asseyeva continues her important studies of bud mutations in the potato. She has now more than 150 mutants under study and concludes that in an overwhelming majority of cases they show the structure of periclinal chimæras.

Percival had suggested that the number of veins in the coleoptile might have systematic value (*Ann. Bot.*, 41, 1927) and M. S. Jakovlev and E. I. Nikolaenko have tested this character over a much wider range of wheats. It appears to have systematic value but to lead to conclusions different from those drawn by Percival, especially in connexion with the Abyssinian wheats. Studies upon rice and upon the durum wheats of the northern Caucasus are also included in this part.

No. 5 contains the results of investigations carried out in the physiological laboratory of the Institute of Plant Industry under the general direction of N. A. Maximov. Naturally, therefore, studies on photo-periodism and upon water relations predominate. V. Rasumov has an interesting paper upon the effects of altering length of day upon tuber formation in a number of races of *Solanum* which had been collected by the Institute in an expedition to South America. Tuber formation in *S. tuberosum* seems to be unaffected by day length, but in several other species a delay is induced by exposure to a longer day.

Jrene Borodin has studied the inter-action of important mineral nutrients upon the reaction of barley and millet to changes in length of day; nitrogen deficiency affects this reaction in barley in an opposite manner to phosphorus or potassium deficiency. The work points to the conclusion that the carbohydrate-nitrogen ratio is not the immediate cause of the change from the vegetative to the reproductive phase but an associated phenomenon. The same conclusion is suggested by V. Rasumov's study of the localisation of photo-periodic effect, which suggests, like similar American work, a direct effect of the period of illumination upon the growing centres.

Sophie Tageeva has an interesting study of photosynthesis under long and short day conditions, which leads to the conclusion that this process proceeds at about the same rate in the plant, however long the period of illumination. On the other hand, a 'long day' plant, like oats, shows under short day conditions a considerably greater accumulation of substance than with a long day, an accumulation which must now be explained otherwise than by a more efficient photosynthetic activity.

Th. V. Bystrikov has a very interesting study of the root system of competing cultivated plants, in which what are defined as secondary crops oust primary crop plants, like wheat, flax, etc., because of a more rapid development of aerial parts and a profuse branching of a more vigorous root system. He states that, in opposition to the views of the textbooks, the primary roots of the cereals do not die off early but remain intact and vital until the beginning of harvest.

Mme. Krasnosselsky-Maximov has attempted to elucidate the internal causes delaying reproduction in the winter forms of cereals. She is led to the conclusion that the winter forms contain a substance, possibly a hormone, which causes delay in reproduction.

The specific nature of the studies on moisture relations can only be briefly indicated. Ivan Vasiljev has a study of the influence of drought upon carbohydrate transformations in wheats. As usual, hydrolysis is increased with desiccation and synthesis with improvement in the water supply. J. N. Kondo has studied the influence of external, as well as internal, developmental factors, upon resistance to drought, whilst S. Kolotov examines the influence of soil moisture as a growth factor, and S. M. Ivanov attempts to determine the frost resistance of plants by changes in the electrical conductivity of the sap induced by frost injury.

Priestley Celebration at the Chemical Society

PRIESTLEY commemoration discourses were delivered before the Chemical Society on April 6 by Sir Philip Hartog, Prof. A. N. Meldrum, and Sir Harold Hartley, and there was also an exhibition of manuscripts, portraits, medals, books, apparatus, and personal mementoes lent by the Royal Society, Dr. Alexander Scott, Mr. G. H. Gabb, Mrs. Arundell Esdaile, Mr. W. C. Priestley, Dr. C. H. Spiers, and Dr. J. A. Newton Friend, or in the possession of the Chemical Society. Unfortunately, few of Priestley's instruments survive, as nearly all of them, together with his books and manuscripts, were destroyed when rioters sacked his house at Farhill, Birmingham, in 1791.

Sir Philip Hartog dealt particularly with Priestley's own peculiar personality and history as a scientific man and theorist, and said that in some ways he had been singularly misjudged. Priestley had an amazing facility for mastering different subjects. He published some fifty works on theology, thirteen on education and history, about eighteen on political, social, and metaphysical subjects, and twelve books and some fifty papers dealing with physics, chemistry, and animal and vegetable physiology. He also knew Latin, Greek, French, German, Italian, Hebrew, Chaldee, Syrian, and began Arabic. The main purpose of his life was one of religion and piety ; his love of science, which he regarded as a relaxation, became obvious at a very early stage. He was the pioneer of the introduction of the teaching of science in schools.

Priestley had a clear vision of the value of hypothesis in scientific investigation, and repeatedly expressed his views on the relation of speculation to facts. Sir Philip Hartog examined and totally rejected the familiar statement that Priestley was 'unable to grasp' the new ideas of the composition of water, showing that he was at one time a convert to those ideas, that his attitude was based on his experimental observations, and that he declared himself ready to be influenced by any new and stronger evidence. Sir Philip Hartog summarised his brief appreciation of Priestley's personal qualities in the words : "Priestley was a glory not only of British science, but of British manhood".

Prof. Meldrum divided his discourse into two parts, showing in the first that Priestley, by his work on gases, made a contribution to science that is unique, and in the second exhibiting his work on nitrogen peroxide. He began by examining two problems which arose in the seventeenth century and were pursued in the eighteenth century by Hales, Black, and Cavendish : the absorption and production of air in general, and the existence of gases distinct from air and from one another. Priestley, who owed much to Cavendish, was self-trained in experimental science ; he made the remarkable admission that his knowledge of chemistry was poor and that he was "not a practical chemist". Chemistry, up to his day, had been concerned so much with solids and liquids that its learning and processes were of little avail in work upon strange gases. Priestley was unique in being the first to handle gases boldly, easily, and quickly. Discussing what is meant by the 'discovery' of a substance, Prof. Meldrum said that Priestley got no credit for the discovery of nitrogen peroxide. He then gave an account of Priestley's preparation of nitric acid, his experiments on nitric oxide and nitrogen peroxide, and his production of nitro-sulphuric acid. The work showed his ardour for discovery, the resources of his mind, and his clever hands that nothing could escape.

Sir Harold Hartley said that Priestley's great service to chemistry was the extensiveness of his work, which revealed to chemists the variety of substances which could exist in the gaseous state, their individuality, and the importance of the part they played in chemical reactions. Priestley often ascribed his discoveries to chance, but in this he was unfair to himself, as he had a real genius for taking advantage of the opportunities that fortune offered him, and many of his researches showed that he could follow up a clue with a fine logical piece of investigation. Sir Harold Hartley described some of Priestley's work in connexion with the composition of the atmosphere, with the analysis of air, and with the practical applications of his discovery of oxygen. Priestley determined the relative density of gases, examined the combination of gases by volume, used solubility determinations as a means of identification, measured coefficients of thermal expansion and the conductivity of sound in gases, compared thermal conductivities, made the first experiments on gaseous diffusion, performed experiments with electricity, and was the first photo-chemist.

The secret of Priestley's genius as an investigator was his enthusiastic energy and curiosity, his fertility of mind, the ingenuity and enterprise with which he devised new experiments with the simplest means, his keen observation, his exceptional visual memory, and the rapidity with which he could develop a new investigation. There was behind everything the impelling force of his love for science, his devotion to experiment, and his boundless faith in the possibilities of new scientific discoveries. Dante's phrase well described Priestley's eager restless spirit, fearless and untiring in the defence of liberty and in the quest of truth : "con l'ali snelle . . . del gran disio".

Origin of the Chile Saltpetre

In the *Chemiker-Zeitung* of February 18, Dr. C. T. Kautter describes some observations which he has made of climatic conditions in Chile, which he believes may throw an interesting light upon the origin of the saltpetre deposits.

In 1924, Prof. Stoklasa suggested that the formation of these beds might be due to a combination of volcanic and bacterial action, the latter being catalysed by radioactivity. In support of his views he investigated a series of samples of caliche in which he was able to determine the existence of 80×10^{-12} gm. radium per gram of mineral. That not only the deposits themselves but also the overlying atmosphere should exhibit radioactivity appears to Kautter to be probable though unimportant. He brings forward the suggestion that the formation of nitrates can be explained by well-known physico-chemical changes which are independent of radioactivity.

The district of northern Chile in which the nitrate is found is undoubtedly volcanic in character and the vastness of the deposits and the absence of characteristic fossils have led to the abandonment of the idea that the caliche is of animal or vegetable origin. The violent thunderstorms which occur with great frequency in the high mountains in the summer are accompanied by discharges at such high potentials that the conditions for the production of nitric oxide are most probably fulfilled. Further oxidation of this gas to nitric acid and its subsequent action upon the common salt which is abundantly supplied by volcanic action would lead to the formation of sodium nitrate, but the transference of the latter to the nitrate zone, some hundred kilometres farther westward, is not so easy to comprehend, for the geological evidence seems to be against the idea of transference by sedimentation.

Now it has perhaps not been sufficiently well recognised that the nitrate zone, which extends about 100 km. inland from the coast and lies between lat. 19° and 26° S., is particularly subject to the visitation of immense cloud-banks of fog, which rise almost vertically to a height of about 1,000 m. against the coastal heights before being carried inland. Close observation has shown that these banks of cloud operate only within a limited and fairly well-defined area, with its centre at the coast and extending to the prairies or pampas, which lie at distances varying from 30 km. to 80 km. from the coast-line. It is significant that the greatest accumulation of cloud is to be found overlying the zone which is richest in caliche. Now these thick clouds, which often hang for long periods over the nitrate zones, may serve as transporters and condensers of the oxides of nitrogen which are formed by the frequent electric discharges. It is also suggested that nitrogen may become activated during the evaporation of the water, though this has not been experimentally verified.

Good deposits of caliche are frequently found not only in the valleys or plains but also at overhanging cliffs on the mountain-sides, wherever any resistance to the flow of the cloud may be offered. These arrested portions of cloud are eventually dispersed by the sun, when the nitric acid is deposited. Further confirmation of this theory is to be found in the fact that isolated deposits of caliche can be traced to the breaking away in certain areas of patches of cloud which drift away from the main areas of concentration.

Thus the deposits of nitrate are formed by the gradual evaporation of the clouds in the enormous basins in the mountainous regions. Even the relatively high concentration of iodine in the caliche, which has sometimes been quoted as evidence in favour of its production from organic remains, can be satisfactorily accounted for on this theory. The iodine content of the air is particularly great at the sea-level. It is stabilised by oxidation by ozone and nitrogen peroxide to iodic acid. Thus the author draws the interesting conclusion that in this case Nature adopts much the same process as that in operation in modern technology, namely, the combined action of water, air, heat and electricity.

Ecology of the Lucerne 'Flea'

The so-called lucerne 'flea', *Smynthurus viridis*, is an insect of the spring-tail group (order Collembola) which is widely spread in Europe. It also occurs in the southern hemisphere, where it has most probably been introduced and, in South Australia, it has become a major pest of lucerne. It is a common insect in Britain and, taking advantage of this fact, Mr. D. Stewart Maclagan has made an extensive study of the rôle of environmental factors in relation to the normal natural increase of the *Smynthurus* population.

Under the title of "An Ecological Study of the Lucerne 'Flea' ", Mr. Maclagan has published (*Bull. Entom. Res.*, **23**, 101–145 and 151–190; 1932) observations carried out, in the main, at the Imperial Institute of Entomology Laboratory at Farnham Royal (Bucks). It is not possible to enter into a detailed consideration of the many important points that are discussed by Mr. Maclagan. In addition to studying the bionomics of the insect, and the effects of predators and parasites upon its survival, a critical analysis of the part played by the physical environment is also presented. The influence of temperature, humidity and soil pH values upon growth, fecundity, and longevity are very fully explored and a general estimate of these combined environmental effects is given. While the first paper is devoted largely to experimental laboratory studies, the second contribution is concerned in the main with the analysis of field data, and the two lines of approach are discussed in conjunction by the author in his conclusions. The value of climatological studies, when checked and analysed by laboratory experimentation, is considered with special reference to the prediction of the possible geographical range of the insect.

The author concludes that the analysis of the complex of environmental factors is an essential preliminary to the study of biological methods of control. The physical environment, he claims, assumes the major rôle in the control of insect populations since it exercises a profound influence on predators, parasites, and hosts alike, resulting in a maze of often unsuspected relationships. Mr. Maclagan's papers form an important contribution to the exact study of animal ecology and are to be commended to the notice of all students of the subject.

University and Educational Intelligence

LIVERPOOL.—Through the gift of Mr. William Horton, the Science Library has gratefully received a sum of money, to be expended over a period of seven years, towards the maintenance of science journals.

The Senate and Council have resolved to confer honorary degrees at the summer graduation on the following: Mr. Stephen Gaselee, librarian and keeper of the papers at the Foreign Office, Miss Eleanor Constance Lodge, until recently principal of Westfield College, London, Prof. G. I. Taylor, Yarrow research professor of the Royal Society, Sir J. Eric Drummond, secretary general of the League of Nations, Mr. R. D. Holt, chairman of the Mersey Dock and Harbour Board, Mr. F. W. H. Groom, until recently head of the Liverpool Institute, the Rev. Father Joseph Howard of Liverpool, Miss D. C. Keeling, secretary of the Liverpool Personal Service Society, and Mr. Percy J. Robinson, chief electrical engineer of the City of Liverpool.

HUDDERSFIELD TECHNICAL COLLEGE has been able to report a record attendance of students during the past academic year, the increase in the number of day students (461) being specially marked. The volume of work has increased by 121 per cent since 1920, when a new Textile Department was opened. Among other developments reported by the Principal are the formation of additional practical classes to meet the extraordinary demand for instruction in smoke abatement and fuel economy and provision for helping unemployed adult engineers by reserving the workshop at certain times for fitters, turners and machinists who wished to practise their trade and to use machines of which they had had no previous experience.

MEXICO'S new rural schools, known as "Houses of the People", are described in Bulletin No. 11 of 1932 of the United States Office of Education, a brief summary of which appears in the November issue of *School Life*. They are the product of a bold scheme designed to build a new civilisation incorporating a revival of the best features of indigenous culture—Mayan, Toltec and Aztec as well as that of the Spanish conquistadors. The federal government selects and pays the teachers and buys the books, but the local community provides the building and equipment and guarantees an ample attendance of both children and adults. As soon as the teacher has been selected, the building of the school is begun, the labour being provided by the community, men, women, and children, working under the direction of the teacher and using materials (adobe brick) obtained locally. Classes are conducted meanwhile in the open air. Courses are not prescribed by the central authorities but the teacher who lives in and knows the community is left to initiate projects of education adapted to local needs. Health, including dietetics, is a basic school subject and the teacher undertakes such simple medical service as vaccination and dispensing remedies for common complaints. The school garden and playground are regarded as indispensable adjuncts. How Mexico finds teachers competent to perform the varied tasks demanded of them is not explained. Hitherto an enthusiastic belief, on the part of teachers and taught, in the value of the scheme appears to have overcome all obstacles to its success.

Calendar of Nature Topics

The Ice Bridge

The Great Lakes of America and the waterways of the St. Lawrence and its estuary are firmly frozen over every winter. The ice begins to break up towards the end of March, and from the middle of April to the middle of May large quantities of drift ice are swept down into the Gulf of St. Lawrence. The opening of this Gulf is almost entirely blocked by Newfoundland and Cape Breton Island, and nearly every year the gap between these islands is completely filled by great masses of ice. This block sometimes lasts for three weeks; it completely prevents the passage of ships, and is known as 'the Bridge'. As many as 300 ships have been held up at one time, and the Bridge is the cause of frequent wrecks on the coast of Newfoundland.

Clover Mites Invade Dwelling Houses

Clover mites (*Bryobia prœtiosa*) live amongst grass and upon the twigs and foliage of many fruit trees. In late autumn the females deposit eggs which hatch in spring, and during April the newly hatched individuals have been known to invade dwelling houses in enormous numbers. In such a case investigated by the writer in 1929, the mites appeared on the outer wall of a house near Edinburgh, on the window sills, and within the house upon the woodwork of the window and shutters, in such numbers that although each mite is less than a millimetre in length, their presence attracted the notice of the householder and was regarded by her as disturbing and troublesome (*Scot. Nat.*, 1929, p. 126). The house was recently built and the explanation of the invasion was that close to it was a grass plot, part of the original pasture field in which the site had been chosen. The invasion lasted several weeks, but the thorough spraying of the grass plot with an insecticide put an end to the plague. In the United States there are records of large numbers of clover mites invading houses, but there the invasions have taken place in the autumn.

The Lambing Season in Great Britain

The peak of the lambing season occurs in spring and indeed it is one of the accepted signs of spring for general observers. Watching the young lambs in field or fold, we may not realise that a farming enterprise of some uncertainty is in progress, in which success or failure depends on a high degree of skill on one hand and much applied science on the other. It is a case of the economical production of an article intended for a discriminating market. The first problem is the choice of suitable breeds of both ram and ewe, and this in itself is no simple matter. In a recent survey of the south-west counties of Great Britain, it was found that no less than 82 distinct crosses were in use. Prolificacy and hardiness in the ewe, with early maturity and quality in the offspring, are the main points looked for, and thus an exacting standard is set up.

The first few weeks of life present many dangers both to mother and offspring, and even under good management serious losses are not uncommon. When this critical stage has been passed a keen watch for disease must still be kept. Veterinary science has already done much to mitigate the effect of internal parasites and foot rot (a virus disease), but there are still obscure troubles, mostly associated with land which has been overstocked with sheep, that cause much unthriftiness and loss.

Knowledge is being sought in two directions. The scientific study of well-recognised problems of nutrition or disease: and the sifting of the very large body of experience which at present exists in an unavailable form in the minds of keen observers—the flockmasters and shepherds themselves. The partnership should turn out to be a very helpful one: the practical man with a highly developed live-stock sense bringing his problems to the scientific expert, and perhaps from his empirical knowledge providing some useful clues for their solution.

Breeding Haunts of the Harp Seal

When the 'fishing' of the whalebone whales in the North Atlantic came to an end, and the whalers from British ports turned to sealing, it was reckoned a lucky day if the ship struck a breeding place of the harp seal (*Phoca grœnlandica*) in the early part of April, for then the crew would be able to slaughter as many as the ship could hold. The reason was that the harp seal is gregarious and in those days was also exceedingly numerous, so that, as Dr. R. W. Gray has quoted from a description written in 1870 by his father, a great whaling and sealing skipper, "fifteen or twenty years ago a pack of [breeding] seals extended in every direction as far as could be seen with a good telescope from a ship's masthead, lying as close as a flock of sheep"; or as Gravill, a Hull whaler and sealer, said, "I've seen them in Greenland [meaning the Greenland Sea] extending on the pack [ice] for a distance of twenty or thirty miles, young ones and old, just a solid body of seals". (*Naturalist*, 1932, p. 183.) The reason why every sealing ship did not return laden when such plenty existed, was that the breeding places were not fixed, their position depending upon the ice conditions and food supply in the Greenland Sea. The harp seal, so named because of the shape of the curious dark line which seems to be stamped on the white coat of the adult, breeds upon the margin of the arctic ice, where it is breaking up into pack ice, for there the seals have at the same time support for their young and the possibility of abundant food in the sea about the ice-floes.

Food of the Harp Seal and its Significance

Harp seals feed upon the small crustaceans in the plankton of northern seas. Dr. R. W. Gray found them to contain *Euthemisto libellula* and *Nyctiphanes norvegica*; and if they also devour the fishes which live upon the plankton, none the less the distribution of the crustacean plankton is of vital significance. Here is a link which connected the whaling and sealing of the nineteenth century, for harp seals and whalebone whales take advantage of the same food supply, so that often enough the whales were captured amongst the floes upon which the seals were breeding. Dr. Gray has analysed, in the paper referred to above, the records contained in the log-books of certain of the Peterhead sealing ships from 1862 until 1891, and has tried to explain the distribution of the former breeding places in relation to the food supply.

The harp seals usually produce their single young in March in about lat. 73° N., north-east of Jan Mayen, where the ice forms a great easterly projecting point exposed to the swell of the ocean on three sides, termed by the old sealers 'the point or end of the sealing ice'. The very large numbers of seals demanded an enormous amount of crustacean plankton. The presence of such abundance, together with pack-ice suitable for the seals, determined the breeding place in lat. 73° north-east of Jan Mayen or in long. 12° W., west or south-west of that island. In years when the western waters were covered by solid ice, and so were locked up from the seals, the breeding place was confined to the eastern position; whereas if the eastern waters were entirely free from ice, and so for another reason were unsuitable for breeding seals, the herds moved to the localities west or south-west of Jan Mayen.

Societies and Academies

London

Physical Society, Feb. 17. M. C. Marsh: The transmission of heat through fabrics. The results obtained in earlier papers have been analysed to determine the effects of air permeability and of perforations on the thermal insulating properties of fabrics. It is also shown that there is a heat-interchange between the convection currents and the fabric which is important in considering the flow of heat through such insulators. L. F. Bates and B. J. Lloyd Evans. A compact electromagnet for general purposes. Special attention has been paid to the construction of the coils, which are cooled by the circulation of oil. J. V. Hughes: On the spurious ring exhibited by fluorescent screens. The spurious ring exhibited by fluorescent screens used for the observation of electrons is explained as being due to total internal reflection of the light at the upper surface of the glass block of the screen. The theoretical intensity-distribution is deduced and is compared with experiment by the use of a specially designed photometer. N. Thomson: The direct recording of relative intensities by means of a microphotometer. An addition to the usual form of recording microphotometer, giving a record on which ordinates are linearly proportional to light-intensities.

Geological Society, Feb. 22. T. E. Longfield: Subsidence of London. This subsidence has been confirmed by a recent, and still continuing, re-levelling of London. The principal lines of levels in this area have been completed and it was primarily from these that the deductions have been made. A comparatively new method is described by which levels can be transferred across water up to a distance of about a mile; this method has enabled the levelling network to be connected with accuracy across the estuary of the Thames at Dagenham and Tilbury. Evidence of (1) a more or less general sinking in the area of the south-eastern counties, and (2) a fairly general subsidence in the Metropolitan area has been obtained. As regards general sinking, the observations showed that the land surface at Felixstowe is lower relatively to mean sea-level by 0·17 ft. than it was fifteen years ago, and if this scale is maintained it would give a subsidence of 1·2 ft. per century, a figure which is of the same order as that arrived at by the estimated lowering of the Neolithic deposits and Roman remains in the Thames Valley, which were respectively 60–70 ft. and 12–15 ft. below mean sea-level. If the results of the first geographical levelling of Great Britain are taken at their face value, these also suggest a lowering of the south-eastern counties by 1–2 ft.

since 1850. A fairly general subsidence has been found in the Metropolitan area; it appears to commence in each case where the London Clay gives place at the surface to gravel, and reaches local maxima in areas of alluvium and over such erstwhile rivers as the Tyburn and the Wall-brook. The draining of water from the gravels is suggested as the cause of this subsidence.

Paris

Academy of Sciences, Feb. 27 (*C.R.*, 196, 581–652). The president announced the death of Johannes Schmidt, *Correspondant* for the Section of Anatomy and Zoology. Elie Cartan: The spaces of Finsler. A. Cotton: The construction of thermoelectric elements. The suggestion of A. Egal regarding the construction of thermoelectric elements had been anticipated by Wilson and Epps in 1920. Charles Nicolle and J. Laigret: The extension of the immunising power of exanthematic viruses by combining the action of two viruses of different origin. C. Gutton and Mlle. M. Chenot: The propagation of electrical oscillations along a tube containing an ionised gas. E. J. Gumbel: The meaning of the constants in the Gompertz-Makeham formula. Alfred Rosenblatt: Some theorems of the theory of ordinary non-linear differential equations of the second order. Georges Giraud: The validity of Fredholm's theory for certain non-limited nuclei. A. Marchaud: The criteria of unicity and of multiplicity by integrals of a system of differential equations of the first order. Eugène Blanc: A differential property of the *continus* of Jordan. E. Crausse and J. Baubiac: Transitory regimes. Experimental study of the transition regime corresponding to setting a viscous liquid in motion starting from rest. Reynolds's law of similitude applies to all the cases studied. Henri Mémery: A remarkable epoch of solar activity (first fortnight in February). From the data available (1880–1933) the author deduces that the sunspots show a tendency to accumulate at certain dates, about the first fortnight in February. Ernest Esclangon: Remarks on the preceding communication. The conclusions in the preceding paper must be accepted with reserve since it would lead to the surprising conclusion that there is a connexion between the production of sunspots and the period of revolution of the earth round the sun, a connexion which logically must be extended to the other planets. E. Prévot: The influence of the daily oscillations of the vertical on the results of high precision levelling. *Attention is directed to the possible consequences of the thermal oscillation of the vertical upon exact geodesic measurements.* J. Solomon: The theory of the diffusion of neutrons. Jean Jaffray: The high-frequency currents produced by high-tension magnetos. If the spark gap is short-circuited, high-frequency currents are still produced; the frequency is independent of the velocity of rotation of the magneto. Nicolas Perakis and Léandre Capatos: The constant paramagnetism of metallic rhenium. Over the temperature interval +20° C. to –79° C., rhenium possesses a paramagnetism independent of the temperature: the coefficient of magnetisation found was about eight times that found by Albrecht and Wedekind. The difference does not appear to be due to impurities. René Wurmser and Mme. Nélicia Mayer-Reich: The equilibrium between lactic and pyruvic acids. Pierre Achalme: The chemical nature of the neutron. If it is assumed that the absolute value of the charge of the negative electron is double that of the positive charge of the proton, an assumption which is in contradiction with no known experimental fact, then the neutron would be formed by the intimate union of two protons and an electron, and would have an atomic weight 2. The author adduces some experimental evidence in support of this view in connexion with the allotropic states of hydrogen. Maurice Nicloux: The oxidation of sodium hydrosulphite by free oxygen. The author's experiments are consistent with the reaction

$$Na_2S_2O_4+O_2+H_2O=NaHSO_3+NaHSO_4.$$

Emile André and Armand Bloch: The presence of ether-esters of glycerol in various elasmobranch liver oils and some analytical characters peculiar to these oils. Marcel Godchot and Max Mousseron: Two methylamino-cyclohexanols and their resolution into their optical antipodes. L. Palfray, S. Sabetay and Mlle. Denise Sontag: The potash dehydration of the β-phenylethyl alcohols halogenated in the nucleus. The halogen styrolenes. Pierre Bedos and Adrien Ruyer: The oxide and polyalcohol derivatives of 1·3-cyclohexadiene. Mlle. Simonne Caillère: Study of the thermal dissociation of the serpentine minerals. P. Fastré: The measurement of the reflective powers of some natural tellurides by the photoelectric method. Fernand Blanchet: The age of the Guillestre marbles, a rock characteristic of the Malm of the *Briançonnais*. Paul Bertrand: The specification of the *Cladoxylon* and *Clepsydropsis* of Saalfeld. Raymond-Hamet: The botanical origin of the drug known under the name of *Muira Puama*. R. Gautheret: Cultures of cells detached from the root cap. Laurent Raybaud: The advantages of germinated grain for feeding farm animals, especially the horse. M. Aron and J. Comsia: Experimental researches on the rôle of functional stimulation in the development of the digestive apparatus in the larvæ of *Rana*. Emile Haas: The accommodation effort of corrected ametropes. Jean Roche and Pierre Dubouloz: Study of the constitution of the hæmocyanins and hæmerythrins by means of their ultra-violet spectra. F. Pasteur: High-tension galvanic electrotherapy.

Rome

Royal National Academy of the Lincei, Dec. 4. F. Enriques: (1) Certain invariant series of groups of points on an algebraic surface. *As an extension of Severi's investigation of rational series of groups of equivalent points on a surface, the construction of an invariant series of groups of points having absolute invariance is considered.* (2) Arithmetic irrationalities occurring in the plane representation of the rational surface with elliptical sections of the eighth order. U. Cisotti: Translo-circulatory current in presence of a circular obstacle furnished with an indefinite rectilinear appendix. Q. Majorana: A new photoelectric phenomenon exhibited by metallic sheets. The increase in the electrical resistance of thin sheet metal under the influence of light is confirmed, and the experimental results previously described modified slightly. Thus silver, although it displays selective sensitivity towards wave-lengths of less than 3000 A., is still sensitive to higher wave-lengths. Further, all the other metals tried, with the exception of aluminium, are distinctly sensitive to ultra-violet light. Various means are available for distinguishing between this effect and the thermal variation of the resistance. G. QUAGLIARIELLO: The presence, in the cells of adipose tissue, of a dehydrogenase acting on higher fatty acids. An enzyme, with an action similar to that of the enzyme recently detected in bile, occurs in adipose tissue. A. COMESSATTI: The canonical series of an algebraic surface. F. TRICOMI: A transcendent equation of statics. M. KOURENSKY: The integration of the equations to partial derivatives of the second order with two functions of two independent variables. (3) Systems containing four derivatives of the second order. R. ZOJA: Distribution of the internal tensions in a solid with rectilinear axis and rectangular transverse section. Uniform distribution of the tangential tension (5). M. BOSSOLASCO: Magnetic measurements at Mogadiscio. Measurements of the magnetic elements during August and September, 1932, show that the secular magnetic variations at Mogadiscio have continued during the past six years, but appreciably more slowly than previously. O. BOTTINI: Relationships between the chemical composition of the soil and that of its colloidal contents. Treatment of three alluvial soils free from lime, by washing with water and decantation, shows that, in such soils, chemical decomposition tends to lixiviation of the bases and silica and so leads to the accumulation of ferric oxide and alumina. Comparison of the elementary composition of the soil with that of its colloidal contents gives an indication concerning the degree to which the soil has undergone degradation: the greater the degradation, the more nearly do the two compositions approach equality.

VIENNA

Academy of Sciences, Dec. 1. ERICH TSCHERMAK: Petaloid formation of the calyx in *Phaseolus multiflorus*. The formation of a coloured, corolla-like calyx, previously observed with garden primulas and auriculas, *Soldanella pusilla*, *Cyclamen europæum*, etc., has now been found in three individual hybrids of *Phaseolus vulgaris* and *P. multiflorus*. ROBERT SCHWINNER: Geology of Eastern Styria: the rocks and their inter-relationships. The rocks occurring in this district, especially in the mountainous district between Foistritz and Lafnitz, are described.

Dec. 9. FRIEDRICH LECHNER: Vibrations of certain systems of valency forces with four mass-points. GUNTHER LOCK: Cannizzaro's reaction (2). In continuation of earlier work, further halogenated derivatives, especially chlorobromo-derivatives, of *m*–hydroxybenzaldehyde, have been subjected to Cannizzaro's reaction. The observation that this reaction occurs only with those derivatives which contain at least one hydrogen atom adjacent to the aldehyde group, is confirmed. KARL GIRKMANN: The calculation of cylindrical liquid-containers in relation to wind pressure. OTTO LICKENBERG: Geological and palæontological investigations in the northern Osterhorn group (Salzburg) (2).

Dec. 15. KARL PRZIBRAM: (1) Recrystallisation and coloration (3). The blue colour change of compressed, irradiated rock salt may be followed down to a loading of 100 kgm. per sq. cm. and a strain of about 2 per cent. The velocity of recrystallisation must be regarded as a function rather of the strain than of the pressure. The repression of the recrystallisation by irradiation previously observed has been confirmed by further experiments with specimens subjected to pressures of 10,000 kgm. (or more) per sq. cm. and also with potassium chloride and bromide; the last salt exhibits especially rapid recrystallisation. (2) Plasticity and hardness of crystals of alkali metal halides. The empirical plasticity law found earlier has been verified by numerous tests with sodium chloride and has been extended to potassium chloride and bromide. Measurement of the Brinell hardness of the three salts reveals, *inter alia*, strengthening by pressure and weakening by recrystallisation. HILMAR SCHUMANN: Petrographic phenomena in the Seckauer Tauern. FRIEDRICH KÜMEL: Outliers of the upper crystalline in the Rosalien Mountains. F. WERNER: New Greek Orthoptera from the region of the Aegean Sea. Observations during November at the Central Office for Meteorology and Geodynamics, Hohe Warte, Vienna.

Official Publications Received

GREAT BRITAIN AND IRELAND

Report of the Rugby School Natural History Society for the Year 1932. (Sixty-sixth Issue.) Pp. 43. (Rugby: George Over, Ltd.).

The Transactions of the Linnean Society of London. 2nd Ser., Zoology, Vol. 19, Part 3: The Percy Sladen Trust Expedition to the Indian Ocean in 1905, Vol. 8, Report No. 12: General Conclusions regarding the Insect Fauna of the Seychelles and adjacent Islands. By Dr. Hugh Scott. Pp. 307–391 + plates 17–23. (London: Linnean Society.)

The Science Forum. Vol. 1, No. 1, February. Pp. 85. (London: International Faculty of Sciences.)

OTHER COUNTRIES

Dominion of Canada. Fifteenth Annual Report of the National Research Council, containing the Report of the President and Financial Statement, 1931–1932. Pp. 169. (Ottawa.)

Indian Lac Research Institute. Bulletin No. 11: Resin Secretion on Different Host Plants by the Lac Insect. By M. Venugopalan. Pp. 11. 8 annas. Bulletin No. 13: Orpiment in Shellac. By Dr. R. W. Aldis. Pp. 7. 1 rupee. (Nankum, Ranchi.)

Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre 1932. Pp. lxii + 102. (Bern: Paul Haupt.)

Bergens Museums Årbok, 1932. Hefte 2, Naturvidenskapelig rekke, Nos. 3–6. Pp. 64 + 57 + 36 + 5. (Bergen: John Griegs Boktrykkeri A.-S.)

Meddelelser fra Kommissionen for Danmarks Fiskeri- og Havundersøgelser. Serie Plankton, Bind 2, Nr. 3: On the Food of the Herring in Icelandic Waters. By P. Jespersen. Pp. 34. 265 kr. Serie Plankton, Bind 2, Nr. 4: Einleitende Untersuchungen über die Stoffproduktion des Planktons. By E. Steemann Nielsen. Pp. 14. Serie Fiskeri, Bind 9, Nr. 6: The "Red Disease" of the Eel in Danish Waters. By Anton Fr. Bruun and Børge Heiberg. Pp. 19. (København: C. A. Reitzels Forlag.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 126: Results of a Citrus Fertilizer Experiment on Sandy Soil. By Dr. Yousif Milad. Pp. 6 + 4 plates. (Cairo: Government Press.) 5 P.T.

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 5, No. 6: Mathematics, No. 3: Beiträge zur Geometrie der Kreise und Kugeln (II). By Soji Matsumura. Pp. 169–206. (Taihoku.)

The Science Reports of the National Tsing Hua University. Series A: Mathematical and Physical Sciences. Vol. 1, No. 6, December. Pp. iv + 215–299. (Peiping.)

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 21, No. 1: The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 1: Foreword. By C. E. Grunsky. Pp. 2. Vol. 21, No. 2: The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 2: Introductory Statement. By Templeton Crocker. Pp. 3–9 + 1 plate. Vol. 21, No. 3: The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 3: The Genus Mollugo in the Galapagos Islands. By John Thomas Howell. Pp. 13–23. Vol. 21, No. 4: The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 4: Characters of Twenty-four New Species of Hemiptera from the Galapagos Islands and the Coast and Islands of Central America and Mexico. By E. P. Van Duzee. Pp. 25–40. Vol. 21, No. 5: The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 5: The Cactaceæ of the Galapagos Islands. By John Thomas Howell. Pp. 41–54 + plates 2–3. (San Francisco.)

CATALOGUES

Catalogue of Books on Applied Chemistry. Pp. 30. Catalogue of Books on Chemistry (Organic: Inorganic: Physical.) Pp. 22. (London: H. K. Lewis and Co., Ltd.)

Catalogue of Microscopic Objects. Part 3. Thirty-third edition. Pp. 60. (London: W. Watson and Sons, Ltd.)

Multipoint Recording Pyrometer. (List No. T22). Pp. 8. (London: Negretti and Zambra.)

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Ethics and Archæology

In these days when public interest in science is growing—in itself an excellent thing, even though not universally regarded as an unmixed blessing—and calls for constant stimulation by accounts of the latest discovery, the problem of acknowledgment and the legitimate use which may be made of the results of recent research is one which in its general bearing affects all research workers in science and its practical and theoretical application.

Apart from the legal question of copyright, to plain straightforward people the rights of discovery at first sight are a simple matter. Credit must be given where credit is due. One rough and ready formula is that facts are free for use, but inference and theory must be attributed to their authors. This, however, is not universally applicable and in many instances is inadequate. In archæology and ethnology, both guidance and a safeguard are afforded by the nature of the material with which these studies deal. Unless a fact is so familiar as to have passed into the generally accepted currency of scientific data, as for example the discovery and determination of the character of Piltdown man, it must be authenticated before it is admissible as evidence. In the physical sciences, it is generally true that a statement of fact can be tested by the repetition of observation or experiment. The ethnologist and the archæologist must rely solely upon an observation which possibly may, but more often cannot, be repeated. When once an archæological site has been investigated by excavation, or an implement or other object has been moved from the exact spot on which it was found, its value as evidence has passed to the excavator's record. The conditions of discovery cannot be restored, and at best, assuming that the investigator is trustworthy and adequately qualified, the evidence as recorded can only be subjected to the test of internal consistency and congruence with the general body of scientific knowledge.

It is true that when the evidence of a material object is invoked, reference can be made to specimens in a museum or collection, as for example Sumerian gold ornaments or an Arunta churinga in the British Museum; but their evidential value in most contexts will be dependent on the fact that the former were found by Mr. C. L. Woolley in certain recorded levels at Ur in Mesopotamia and the latter was acquired by, let us say, Spencer and Gillen while it was actually in use among aborigines in Central Australia. Thus authentication and acknowledgment go hand in hand and are inseparable. In practice, any departure from this observance is unscientific, as well as lacking in a sense of obligation.

The Editor of *Antiquity*, in a recent issue of that journal, touched upon this point of ethics in archæology, referring to "the exploitation of other peoples' work before they have been able to exploit it for themselves" as a "Fleet Street pastime", and his comment was followed up by a correspondent, who asked for a ruling upon the length of time which should elapse before an exhibit in a museum may be considered available for the purposes of archæologists in general. The Editor of *Antiquity* having stated that he does not intend to discuss the matter further, we propose to offer some comments, dealing specifically with archæology and kindred studies.

As to how far it may be legitimate for an archæologist or ethnologist to make use, as material for his own work, of objects placed on exhibition in a public museum—naturally question does not arise in the same form in a museum in which the collections are privately owned—and whether there should be a 'closed time' for reference to such objects, the problem has been complicated by practices which have grown in recent years. In the ordinary course, it would be safe to say that any object which has been placed in a public collection and is open to the inspection of the public, is available for citation. If for any conceivable reason complete publication were not desirable, it would be within the discretion of the museum authorities; for presumably a photograph or accurate drawing would be an essential to such publication, and permission for access to the object for that purpose could be withheld.

This, however, affects only objects which come into the museum collections in the ordinary course; a more difficult question arises when a more or less extensive group of objects is shown as a collection of unitary interest. Owing to the growth of public interest in the expeditions of archæological exploration in which the museums, and especially the British Museum, now participate, such as that of Mr. Woolley at Ur, it has become a regular feature of the archæological year that the season's finds allotted to the Museum, and usually those allotted to other participants in the expedition while awaiting distribution, should be shown to the public for some weeks. This takes place before any report is sent to the excavator, and obviously places him at a disadvantage should he wish to make special use of any of the material, even if he were not busily occupied in clearing up the thousand and one loose ends after a season spent in the field.

The question of the use of the evidence afforded by the material objects thus exhibited, before the excavator has had time or opportunity to express his views concerning their bearing on the more general aspect of the problems upon which he is at work, is closely analogous to amplification or inferential treatment based upon either the isolated announcements of important discoveries or the periodical reports on work in the field, which it is now customary to send home for publication in the technical journals or even in the daily press. When archæological fields are so closely related in theoretical discussion and reconstruction as they are to-day, and students of prehistory are working along cognate lines of inquiry in which the evidence from one field may at any moment throw light upon the problems of another, it is difficult to draw any line beyond which it is fair to say there lies the exclusive field of original discovery.

Further, however nice the feeling which would err on the side of discretion rather than offend, there unquestionably must be a time limit. It is not every archæologist who is so prompt as Sir Flinders Petrie in the publication of the facts which have been brought to light by his excavation. Time and again, archæologists have had cause to deplore the delay in publication which has hampered research. Only recently in a notable archæological work, the author felt constrained to confine himself to one period only of his subject, and that not the most interesting, because the official report of the excavations in which he himself had participated was not yet published, although some years had elapsed.

There is another aspect of this question in which perhaps some relaxation of rule might be admitted. This is the popular exposition of the progress of discovery, however much this may be regarded as a "Fleet Street pastime". Any more extended understanding of the objects of archæological investigation among the more intelligent section of the public benefits the science in the long run. But to those who have no technical knowledge and whose acquaintance with even the barest outlines of knowledge of the prehistory of any specific area is of the sketchiest, the simple announcement of a discovery or even the account of the progress of an excavation is of little interest. It must be provided with a background, and it must be assigned to its place in some scheme of knowledge which is likely to be familiar to at least a fair proportion of its readers. Even so, it does not necessarily follow that the writer must be guilty of unjustifiable exploitation; but should that happen, the number of writers whose technical knowledge is sufficient to allow them to prejudice seriously the position of those who have first claim, is probably limited enough to ensure that punishment will follow and that it will fit the crime.

Modern Aspects of Chemistry in Space

Stereochemie: eine Zusammenfassung der Ergebnisse, Grundlagen und Probleme. Herausgegeben von K. Freudenberg. Lieferung 1. Pp. vi + 160. 18 gold marks. Lieferung 2. Pp. 161 – 320. 18 gold marks. Lieferung 3. Pp. 321 – 480. 18 gold marks. (Leipzig und Wien: Franz Deuticke, 1932.)

THE publication of an authoritative work on stereochemistry by a team of workers under the leadership of Prof. K. Freudenberg is a development which will be welcomed by many chemists. It is a sign of the times that an organic chemist should have secured the co-operation of so many workers outside his own field; and the thoroughness with which their co-operation has been sought and used is shown by the fact that Part I, dealing with aspects of the study of "Chemistry in Space" which have come into existence exclusively during the last two decades, includes chapters by Goldschmidt, Mark, Mecke, Wolf and Werner Kuhn, all of whom have in recent years been invited by the Faraday Society to take part in its general discussions, and are thus already well known to workers in Great Britain. It is therefore a very attractive scheme whereby each of these pioneer workers has been given an opportunity of providing an up-to-date report on the subjects in which he is specially interested.

These reports have, however, been written on the assumption that the organic chemists who read them are competent mathematicians, with an ample knowledge of physics, since no concession is made to the preference for chemical rather than mathematical equations and formulæ which sometimes decides the choice between organic and physical chemistry. The two subsequent parts, dealing respectively with the stereochemistry of carbon and of other elements, will include the topics which two successive generations have discussed under this title. The whole work is to be published in about eight instalments; but British chemists will be staggered when they receive a bill for considerably more than a pound sterling for an instalment of 160 pages.

(*a*) Prof. Goldschmidt's report on the "Crystallography and Stereochemistry of Inorganic Compounds" includes a study of atomic and ionic radii, on the lines of the author's lecture to the Faraday Society in 1929, but of much wider scope. As a contribution to a book on "Chemistry in Space", it is easy to follow, since the reader may be assumed to have acquired the habit of 'thinking in three dimensions', even if Einstein's fourth dimension is still beyond his powers of imagination. The numerous diagrams, in which the centres of the atoms are indicated by small well-spaced circles, are also clear and easy to understand, although the difference between the zinc oxide and zinc blende structures is not adequately explained in the text. The suggestion (on p. 70) that crystals of iron pyrites contain "the molecules S_2 which are already known in the gaseous state", is however perhaps ambiguous, since the reviewer has always regarded the twinning of the sulphur atoms as evidence that iron pyrites is a *ferrous disulphide*, $\overset{++}{\mathrm{Fe}}\,\overset{-}{\mathrm{S}}\text{–}\overset{-}{\mathrm{S}}$, containing a bivalent diatomic anion which may be compared with the peroxide ion in compounds such as $\overset{+}{\mathrm{Na}}\,\overset{-}{\mathrm{O}}\text{–}\overset{-}{\mathrm{O}}\,\overset{+}{\mathrm{Na}}$, or with the diatomic mercurous ion $\overset{+}{\mathrm{Hg}}\text{–}\overset{+}{\mathrm{Hg}}$ in mercurous nitrate. The report concludes by describing the fascinating work of W. L. Bragg on the silicates, of which an account has already been given in English in the new edition of the reviewer's "Inorganic Chemistry".

Two additional structures which might have been cited in detail are palladium monoxide, PdO, where each atom of palladium is surrounded by four coplanar atoms of oxygen at the corners of a *square*, whilst each atom of oxygen is surrounded by four atoms of palladium at the apices of a *tetrahedron*; and molybdenum and tungsten disulphides, MoS_2 and WS_2, where each atom of metal is surrounded by six atoms of sulphur at the corners of a *triangular pyramid* instead of the more familiar *octahedron*. These structures, which are illustrated by figures in a recent article by Maurice Huggins in *Chemical Reviews*, are so suggestive, as illustrations of the applications of X-ray analysis to stereochemical theory, that they might well be given a conspicuous place in a future edition of the present work.

(*b*) Prof. Mark's three contributions include an introductory report on "The Basis of X-Ray Analysis of Crystals", which does not call for special comment.

The second contribution, on "Interferometric Study of Molecular Form", supplements Prof. Goldschmidt's report, since it deals with the determination of interatomic distances in gaseous molecules by the diffraction of X-rays (Debye) and of electrons (Wierl), and with the application of X-ray analysis to solid organic compounds. A summary of the results obtained by the methods of Debye and of Mark and Wierl is very useful at the present stage, and their concordance is quite remarkable. Wierl's observations on pentane, hexane and 1:5-dichloropentane are particularly interesting in that the only spacings shown by the two hydrocarbons are 1·5 A. (between contiguous carbon atoms) and 2·5 A. (between alternate atoms), since these are unaffected by free rotation about the single bonds. The absence of a well-defined spacing between the two chlorine atoms of the pentane derivative confirms the conclusion that the hydrocarbon chain is not a stiff zigzag, although the mutual repulsion of the protons may suffice to impart a linear orientation to the hydrocarbon chains in the process of crystallisation. The free rotation or 'spinning' of a long hydrocarbon chain in crystals of the substituted ammonium halides provides another example of flexibility of molecular structure where rigidity might have been expected.

The absence of all but a centre of symmetry in the molecules of crystalline benzene is recorded; but observations of the diffraction of electrons in the vapour have shown that the carbon atoms form a "regular hexagon with an edge-length of 1·39 ± 0·03 A.U." Nevertheless in Fig. 16, a zigzag ('chair') configuration is assigned to the two aromatic rings of diphenyl. This also exhibits a centre of symmetry, so that the rings must be coplanar, instead of being twisted relatively to one another about the long axis of the molecule. The report concludes with an account of the results obtained by the X-ray analysis of long-chain hydrocarbons, fatty acids, synthetic polymers, natural polymers such as cellulose and rubber, and protein chains such as the silk fibre, in reference to which Meyer and Mark have already published an important volume.

The third contribution, on "Directed Valency from the Point of View of Quantum Mechanics", gives a most illuminating account of the way in which the newer quantum mechanics has replaced the localised electrons and electron orbits of earlier theories by electron clouds, the density of which is a measure of the probability of the electron being found at a particular point. The way in which the fine structure of the L-shell has been correlated with the angles between the bonds in compounds of oxygen, nitrogen and carbon is explained very clearly; and an interesting estimate is given to the effect that work amounting to 600 cal. per mol. would be required to bend through 5° the straight bonds between HC and CN in hydrogen cyanide, whilst 1000 cal. per mol. would be required to distort by 5°–10° the tetrahedral angles between the bonds in diamond.

(*c*) Prof. Mecke's report on "Band Spectra and Stereochemistry" covers only thirty pages and is therefore perhaps too concise for chemical readers who are not already familiar with the subject. In particular the equations which are used to describe the P, Q and R branches of a band spectrum might have been accompanied by a description of the phenomenon in general terms, for the benefit of the non-mathematical reader. In view of its great importance as evidence of complete symmetry in gaseous molecules, the phenomenon of alternating intensities in band spectra might also have been described in greater detail by the author who discovered it.

One of the most interesting features of this report is the description of the 'binding constant', k, which Mecke himself has introduced to represent the work which would be needed to double the distance between the atomic nuclei of a molecule, on the assumption that Hooke's law remained valid throughout. A paragraph in small print explains that, in order to double the size of a water molecule by stretching the bonds, an expenditure of about 1,000 kilogram calories per gram molecule would be required, whereas the work done against cohesion in doubling the volume of liquid water would be about 8 kilogram calories.

The values of k, as calculated from the vibration frequency and the moment of inertia of the molecule, are fairly constant at 27, 54 and 77 volts, for single, double, and triple bonds, and can thus be used to diagnose the nature of the bonds. Chemists will, however, be very reluctant to accept the conclusion that the structure of carbon dioxide is similar to that of carbon monoxide, containing quarter-polar quadruple bonds, with three covalent linkages between carbon and oxygen, thus:

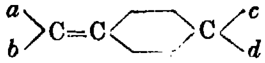
$$\begin{array}{ccc} :C:::O: & :O:::C:::O: & :N::N:::O: \\ \text{or } \overset{-}{C}\equiv\overset{+}{O} & \text{or } \overset{+}{O}\equiv\overset{--}{C}\equiv\overset{+}{O} & \text{or } N\equiv\overset{-}{N}\equiv\overset{+}{O} \\ \text{Carbon monoxide.} & \text{Carbon dioxide.} & \text{Nitrous oxide.} \end{array}$$

Indeed, the evidence for this formula is not very convincing, since the 'binding constant' is only 61 volts for CO_2 and 62 volts for N_2O, as compared with 54 volts for the double bond in C_2H_4 and 70 volts for the triple bond in C_2H_2. Other values recorded in the table are 55 volts for CS_2 and SO_2, 78 volts for the triple bond in HCN, 77 volts for CO and 85 volts for N_2.

(*d*) Prof. Dadieu's report on "Raman Effect and Stereochemistry" supplements Prof. Mecke's more general spectroscopic report. Raman spectra can be produced by symmetrical vibrations, which cannot be excited by the absorption of infra-red radiation; they therefore provide a valuable method of diagnosing the origin of the individual lines. Moreover, by means of a weak Raman line, with the vibration frequency of a double bond, Dadieu and Kohlrausch have detected the presence of HNC as a minor component in prussic acid, the spectroscopic properties of which are predominantly due to HCN.

(*e*) It would be difficult to praise too highly the report by Wolf and Fuchs on "Structure in Relation to Electrical Properties". In the theoretical sections, the symbols differ from those used in Debye's book on "Polar Molecules", and are rendered obscure by the use of too many subscripts. The methods for determining dipole moments are, however, adequately described, illustrated and discussed; and it is a special merit of this report that it deals also with the cognate phenomena of depolarisation of scattered light by anisotropic molecules, and the Kerr effect of double refraction in an electrostatic field. The collection of experimental data is remarkably complete, and has the advantage of being classified in a series of more than twenty tables, so that abundant data are at once available to illustrate every theoretical point that is raised by the author, or that may occur to the reader. In particular, the problems of free and impeded rotation and of distortion of valency direction are presented with full experimental evidence for the conclusions that are reached.

(*f*) Dr. Werner Kuhn's report on "Optical Activity" deals with the fundamental property of optical rotatory power, which led to the initial development of three-dimensional chemistry by Pasteur nearly a century ago. It is therefore unfortunate that in an early paragraph the author appears to underrate the importance of the classical experiment, whereby Pasteur first resolved sodium ammonium racemate into the *d*- and *l*-tartrates, since he claims that (by making use of the selective decomposition of *d*- and *l*-azidopropionic dimethylamide by circularly polarised light) he has developed the "only method whereby up to the present the optical antipodes of a racemate can be separated arbitrarily without the aid of other optically-active substances". A similar criticism is invited by a statement that "optically active compounds containing one asymmetric carbon atom, e.g., the compound



had already been discovered in the time of van't Hoff", whereas in fact a compound of this type was first resolved by Pope, Perkin and Wallach in 1909, which was thirty-five years after the publication of van't Hoff's "Chemistry in Space", although two years before his death in 1911.

Dr. Kuhn's report consists mainly of a description of the views which he has himself put forward during the past four years; and a considerable part of the report has been taken verbatim from a recent monograph by Kuhn and Freudenberg under the title "Drehung der Polarisationsebene des Lichtes"[1]. The hypothesis is adopted that optical rotatory power is developed by an unsymmetrical coupling of electrons, such that when one vibrates in a north-and-south plane the other has a component vibration in an east-and-west plane. Thus the major component of the rotatory power of azidopropionic ester is attributed to the coupling of the electrons of the azido-group (which gives a weak absorption band in the middle ultra-violet) with the electrons associated with the asymmetric carbon atom (which is supposed to possess an extremely intense band in the inaccessible Schumann region). The development of optical activity by the coupling of electrons is described by him as "vicinal action".

In this connexion attention may be directed to a letter in NATURE of April 19, 1924, on "Induced Asymmetry of Unsaturated Radicals in Optically-active Compounds"[2], which is cited in Kortüm's recent monograph, but not in the present report. In this letter, the hypothesis was put forward "that unsaturated chromophoric groups can be made asymmetric by induction from a fixed asymmetric centre, and thus develop optical activity"; "induced asymmetry" was, however, only attributed to the chromophoric groups *when coupled sufficiently closely to an asymmetric complex*. This hypothesis was based on the experimental fact "that the dispersion equations for camphor and its derivatives are haunted by a low-frequency term *the period of which is definitely characteristic of the ketonic group*."[3] In a similar manner, Kuhn was able to show some years later that the azido-group which (like the ketonic group) normally contains a plane of symmetry, nevertheless produces an important partial rotation in the azido-propionic esters. The optical activity which was attributed in 1924 to the "induced asymmetry" of the unsaturated radical is attributed by Kuhn to the "induced anisotropy" of the absorption band of this radical; but the correct term for the phenomenon is obviously "induced dissymmetry" or "induced optical activity", since anisotropy alone cannot produce optical activity, and complete asymmetry although usual is not essential.

Dr. Kuhn's model leads to mathematical equations of a type which had already been developed by Drude in 1906; but these have been adapted to absorption bands of a form which agrees more nearly with that which is observed in practice. These equations, however, now provide a numerical estimate of the distance between the coupled electrons, with the interesting result that the distances thus calculated are considerably greater than the extreme linear dimensions of the molecule. Another important deduction states that, since the process of coupling affects both electrons, the sum of the partial rotations (for example, as expressed by the numerators in Drude's equation) must be zero. A 'simple rotatory dispersion' then results, as the algebraic sum of partial rotations of similar frequency, when *all* the active absorption bands are in the Schumann region, whilst complex and anomalous rotatory dispersions result when one or more of the bands is in the visible or in the accessible ultra-violet region.

(*g*) Part I concludes with a report by Dr. Stefan Goldschmidt on "Reaction Velocity". This report (of which only one-half is included in the third instalment) does not call for detailed criticism at this stage, since it consists mainly of a review of the evidence for and against the doctrine of "Steric Hindrance" in organic reactions of many different types. It does not therefore break new ground in the same way as the reports which precede it, but it will nevertheless be of real value to those who require a guide to the literature dealing with this phenomenon.

T. M. LOWRY.

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[1] "Hand- und Jahrbuch der chemischen Physik," Band 8, Abschnitt 3.
[2] Lowry and Walker, NATURE, 113, 565, April 19, 1924.
[3] Lowry and Cutter, *J. Chem. Soc.*, 127, 618, 1925.

Nomenclature in Lepidoptera

The Macrolepidoptera of the World: a Systematic Description of the hitherto known Macrolepidoptera. Edited by Prof. Dr. Adalbert Seitz. Supplement to Vol. 1: *The Palæarctic Butterflies.* Pp. vii+399+16 plates. (Stuttgart: Alfred Kernen, 1932.) 132 gold marks.

IN the supplement lately issued to the volume of Seitz's "Macrolepidoptera" dealing with the palæarctic butterflies, the editor and his collaborators have, within their self-imposed limits, produced a work of great value and of high interest. How far these limits will commend themselves to students of the various groups concerned, may be doubtful; it is at least certain that disputable points have been carefully considered, and that in most of the decisions arrived at account has been taken of the dictates of common sense.

"It is impossible in these supplementary volumes," the editor remarks, "to take up an extreme attitude either in the nomenclature or with the giving of new names." That the latter proceeding can be carried to excess is evident from the fact that more than one hundred forms of one species of *Parnassius* have each received a name. Most people will agree with the editor that "nomenclature itself is not a science, but that it should be an aid to science. As soon as it proves itself the reverse it is worse than useless and should be opposed." There can also be little doubt that names which are merely abbreviated diagnoses, such as *croceosemivirgatus-cœrulescens*, should be disallowed as a retrograde step towards the system happily reformed by Linnæus. At the same time, the trinomial system now so widely adopted serves a useful purpose in grouping together, under a common specific designation, various closely related but distinct forms which may be judged not to be deserving of specific rank. But here also restraint is necessary; a tendency of the trinomial to become a quadrinomial or multinomial system should generally be checked.

In the matter of specific names, assent will probably be given by most lepidopterists to the principle laid down by Prof. Seitz that the form first described, even when it is a comparatively rare and inaccessible 'subspecies', should retain the specific appellation; other subspecies adding their distinctive designations to the common name denoting the species.

An inherent difficulty in the whole matter is the fact that nomenclature has to presuppose the existence of hard and fast lines where such do not exist in Nature. Perfect correspondence between the system and the facts is unattainable; every student will have his own idea of the best form of compromise. What is to be aimed at in practice is the establishment of a well-considered standard of nomenclature, sufficiently reasonable to induce students to sink their individual opinions and preferences for the sake of general agreement.

The editor and his collaborators have borne in mind throughout that their undertaking is mainly intended as a work of reference and not of criticism. This justifies the admission of many new names that from a strictly scientific point of view might well be disallowed. On the whole, they have exercised a wise discrimination, and have been guilty of few, if any, sins of omission.

Leaving aside the topics dealt with in the preface and introduction, we have found little to call for special notice. A discoidal cell (p. 8) should not be called "open" merely because it is not bounded by a black streak. The view expressed (p. 93), that a name should only be given when specimens can be denominated even without the particulars of the locality and the date, seems, on the whole, reasonable. But it would not be difficult to suppose cases where the rigid application of such a rule might be inadvisable.

The English version of the book is for the most part well executed; but one is inclined to suspect that the intricacies of the English language have occasionally been a little too much for the translator. The plates, sixteen in number, reach a high standard of merit.

F. A. D.

Short Reviews

Business Rationalisation, its Dangers and Advantages considered from the Psychological and Social Standpoints: Three Lectures given at the London School of Economics under the Heath Clark Bequest to the National Institute of Industrial Psychology. By Dr. Charles S. Myers. Pp. vii + 76. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 3*s*. 6*d*. net.

THIS book attempts to give a more comprehensive picture of rationalisation than is suggested by its title, and in emphasising the importance of the human factor in rationalisation and the bearing of rationalisation on the general structure of society the book makes a needed and valuable contribution. In discussing the significance of rationalisation, Dr. Myers has scarcely placed sufficient emphasis on the growing tendency under modern conditions for the really progressive large combines to display in their general policy a remarkable approximation to the spirit of service characteristic of what might be termed national service or public utility departments. This tendency is likely to become even more pronounced, and public opinion will judge rationalisation largely by the extent to which service rendered to the community in the broadest sense dominates the policy of the rationalised combines.

On the question of leadership and particularly on the development of leadership by scientific management in industry Dr. Myers has little to say, though he notes the importance of personality, and his treatment of the dangers of rationalisation is too academic. Similarly in discussing its advantages, Dr. Myers has rather strangely omitted to set rationalisation in its true perspective in an age which demands increasing world co-operation, or to discuss the significance of international industrial co-operation for world peace. More care might have been taken to distinguish rationalisation from mere amalgamation, for such confusion is responsible for widespread misunderstanding of, and opposition to, valuable and overdue schemes of rationalisation in certain industries.

The subject headings of the chapters are by no means happily chosen; some of the most important observations on the dangers of rationalisation are to be found, for example, in the other chapters. The book just misses an opportunity for a timely exposition of rationalisation from an aspect which is of growing importance but often overlooked.

R. B.

Industrial Psychology in Practice. By Henry J. Welch and Dr. George H. Miles. Pp. xiii + 249. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 7*s*. 6*d*. net.

NUMEROUS examples drawn from many different industries, illustrating the practical results which have already attended the application of the methods and principles of industrial psychology to commercial and industrial problems, are recorded in this volume, which demonstrates convincingly the value of such applications alike from the point of view of the worker and of the employer. The fact that investigations of working conditions such as lighting, heating and ventilation, noise, or hours of work, fatigue and monotony and the most effective method of carrying out a specific operation or process have almost invariably increased the efficiency or output of the worker has frequently led to an even more important result being overlooked—the improvement in the health of the worker, who is also less fatigued by the effort required for the greater output under the new conditions. Industrial psychology is clearly of the utmost importance from both points of view and this book tends to redress the balance of emphasis by stressing the importance of such methods to the worker in the prevention of accidents, in the planning of work and elimination of waste, the selection and training of personnel, etc.

Material has been taken freely from the reports of the Industrial Health Research Board, the Home Office Safety Pamphlets, the investigations of the National Institute of Industrial Psychology, as well as from foreign sources, and the book demonstrates conclusively the immense value of the human sciences to the community, and the wide possibilities in the settlement of human problems not by opinion, rule of thumb or tradition, but by scientific methods based on ascertained facts. It should be of great service in enlisting further support for the work of the Industrial Health Research Board and the National Institute of Industrial Psychology, and in encouraging the wider application of such methods in industry.

R. B.

Bibliographical Survey of Vitamins, 1650–1930: with a Section on Patents. By Mark H. Wodlinger. Compiled by Ella M. Salmonsen. Pp. viii + 334. (Chicago: Mark H. Wodlinger, 1932.)

THE literature of the vitamins now runs to several thousand original papers. In this bibliography, more than 11,000 publications are mentioned; 326 references appear in the historical section covering the period 1650–1910. Thereafter the papers of each year are listed separately, and from 1916 onwards a separate section is devoted to each vitamin: vitamin E first appears in 1921.

The earlier references are, of course, to the deficiency diseases, which we now know to be caused by the absence of a particular vitamin from the diet, and also to medicaments such as cod liver oil which owe their efficacy to their content of vitamins, although this was not realised at the time their use was originally advocated. These early references will be of special value to those interested in the historical side of the subject and might form the basis of a study of the development of our knowledge of the real cause of different deficiency diseases.

The references to each vitamin are arranged in the alphabetical order of the authors' names: provided the name is known it takes but a moment to find any particular paper, even although the year of publication is not known. It would take only a short time to extract from these pages a list of papers dealing with any particular aspect of the vitamin problem, since the title of each paper (or book) is given in full.

This book should be of great use to all workers in this field: it supplements the reviews and monographs on the vitamins and precedes the issue of *Nutrition Abstracts and Reviews*, which should now provide an adequate index to the literature. In the last section the list of 240 patents should be of value to manufacturers or to research workers who may wish to patent their process.

A History of the Birds of Suffolk. By Claud B. Ticehurst. Pp. xi + 502 + 18 plates. (London and Edinburgh: Gurney and Jackson, 1932.) 24*s.* net.

WITH the progress of ornithological interest it is impossible to work with a book that is forty-five years old, however good it was when published. Those interested in the birds of Suffolk will welcome an up-to-date work by one who is singularly competent to write it. From the hours of a busy life, Dr. Claud Ticehurst was able to take some leisure and to make his notes and record his observations. He has spent twenty years in producing this volume, seventeen of which were spent in Lowestoft.

In the introduction are given a description of the country; changes in the avifauna; migration; a list of the collection of Suffolk birds; the names of former Suffolk ornithologists and the scope of the volume explained. The order and nomenclature used are those of the "List of British Birds" published in 1915. We think the 1923 "List" would have been preferable. The species are treated on modern lines, doubtful records examined and the latest and most reliable views expressed. The photographic plates add to the work and the map of Suffolk is, of course, a necessity.

Einführung in die Mechanik und Akustik. Von Prof. R. W. Pohl. (Einführung in die Physik, Band 1.) Zweite verbesserte Auflage. Pp. viii + 251. (Berlin: Julius Springer, 1931.) 15.80 gold marks.

THIS second edition of Prof. Pohl's elementary treatise should need little commendation to the notice of English readers. Its treatment of the subject is well off the lines of the traditional method and, both in its insistence on apt experimental illustration, and in the small demand it makes on the reader's mathematical knowledge, it forms an effective foil to the conventional English textbook. It is to be hoped that a translation, modified a little (in scope rather than in outlook) to suit the work of the junior university and senior classes of schools, will make the book available to those who cannot read the German text. Despite the excellence of the text, such modifications would seem to be needed, more especially in that section which deals with acoustics.

A notable feature of the book is its wealth of illustrations, many of them produced most effectively as deep black silhouettes.

A. F.

Early History of the Determination of Atomic Charge

ATOMICITY is a characteristic of twentieth century physics, so that modern physics may be said to begin with those early investigations by which the atomic nature of electricity was first established. The facts relating to early investigations of the atomic charge are scattered through the literature of the subject, and it will be of interest to bring them together in a brief account of the development of the methods which led to the accurate determination of this fundamental constant.

That electricity has an atomic structure appears first to have been suggested to explain Faraday's laws of electrolysis, on the supposition that the charge on a monovalent ion was the smallest separate quantity. This hypothesis was strongly advocated by Stoney and Helmholtz. It follows from Faraday's experiments that if E be the charge on a monovalent ion in a liquid, and n the number of molecules in a cubic centimetre of a gas at 15° C. and 76 cm. pressure, the product $n.E$ is $1 \cdot 24 \times 10^{10}$, E being expressed in electrostatic units. This E is taken as the *fundamental atomic charge*.

The quantities n and E could not be deduced separately from experiments on electrolysis, and in the earliest attempts to determine E the above value of $n.E$ was used with approximate estimates of n. All that was known about n prior to a direct measurement of an atomic charge, was that "it lies between the limits 10^{18} and 10^{21}" as stated by Sir J. J. Thomson in his book "The Discharge of Electricity through Gases" published in 1898, where he also gives a description of the first experiments on the direct determination of the atomic charge made by Townsend,[1] who was at that time demonstrator in the Cavendish Laboratory, Cambridge.

These experiments of Townsend are notable as being the prototype of the investigations which led finally to the accurate determination of the atomic charge made by Millikan.

It was known that in many cases electrically charged clouds were formed when newly prepared gases were bubbled through water. Townsend conceived the idea of measuring the charge on a drop in such a cloud, which he supposed to be an atomic charge, and for this purpose he used gases prepared by electrolysis, adopting the following procedure. The total weight W of the drops in a cubic centimetre of the cloud, and the total charge Q carried by them, were found by direct measurements, but in order to determine the average charge on a drop it was necessary to find the number of drops in a cubic centimetre of the cloud; to obtain this number the weight w of a drop was required.

The weight of a drop and also its radius were obtained from the rate of fall of a cloud in a beaker, by an ingenious application of Stokes's formula for the velocity of a sphere moving slowly in a viscous medium under the action of a constant force. The first value found for an atomic charge was 3×10^{-10} E.S.U., but after allowing for the fact that the cloud contained drops with charges of different sign, Townsend[2] gave a corrected value 5×10^{-10}.

The importance of this investigation was immediately recognised, and in 1898 Sir J. J. Thomson used the same method modified in details to investigate the charge carried by ions produced by X-rays. In Thomson's experiments a cloud was formed in a closed vessel as in C. T. R. Wilson's experiments in which an ionised gas is cooled by a sudden expansion causing water vapour to condense on the ions. With this modification, it was necessary to determine the charge Q per cubic centimetre and the weight W indirectly, consequently Q was obtained from the electrical conductivity of the gas and W by estimating the amount of moisture condensed on ions by the expansion.[3] The gases were ionised by X-rays and the values $6 \cdot 5 \times 10^{-10}$ E.S.U. and $6 \cdot 7 \times 10^{-10}$ E.S.U. found for the charge on a drop in air and hydrogen respectively. Later he obtained the value $6 \cdot 8 \times 10^{-10}$ for negative ions generated by the action of ultra-violet light.[4] In a subsequent determination[5] which he considered to be more accurate, he used a radioactive substance to ionise the gas, obtaining for the value of the atomic charge $3 \cdot 4 \times 10^{-10}$.

The determinations of Townsend and Thomson involve various inaccuracies, and also the serious uncertainty in the assumption that each drop in the cloud carried a single atomic charge. Millikan states that, in the clouds produced in ionised gases by expansion, some of the drops may carry one, some two, some ten or almost any number of unit charges, though this does not imply that before condensation the ions in the gas have multiple charges.

There remained, in addition, the difficulty of establishing a relation between the charge e on an ion in a gas and the charge E on a monovalent ion in an electrolyte. A method of showing that these charges are identical was first given by Townsend[6], who showed that if e be the charge on an ion in a gas, U its mean velocity in the direction of an electric force Z, and K the coefficient of diffusion of the ions, then the value of $n.e$ is obtained from the equation $U/K = n.e.Z/P$ where P is the pressure of a gas containing n molecules per cubic centimetre at the temperature at which U and K are determined ($P = 10^6$ C.G.S. units).

In order to find the product $n.e$, Townsend devised a method by which he measured the coefficient K, and taking the mean values of K for moist and dry gases with the corresponding values of U obtained by Rutherford, he found the following values for $n.e \times 10^{-10}$: air $1 \cdot 35$; oxygen $1 \cdot 25$; carbon dioxide $1 \cdot 30$; hydrogen $1 \cdot 00$.

These values of $n.e$ were so near the value $1 \cdot 24 \times 10^{10}$ of $n.E$ for monovalent ions in a liquid that Townsend was able definitely to state that the charge on ions produced by X-rays and the charge E on a monovalent ion in a liquid are the same. In later investigations in which the ions were produced in various ways, he found that the value of $n.e$ for negative ions in gases was in close agreement with the value of $n.E$ for electrolytic ions.

Further progress in the accurate determination of e was made when H. A. Wilson introduced an important improvement into the method of finding the charge on a drop, whereby it was possible to avoid the uncertainty of dealing with drops with an unknown number of atomic charges. The cloud was formed in the ionised gas by expansion, in an apparatus containing two horizontal parallel electrodes, so that it was possible to establish a vertical field Z in the space where the cloud was formed. A retarding or an accelerating force, $Z.e$, was thus superimposed on the force of gravity w acting on each drop. The weight w of a drop was determined by measuring the velocity when Z was zero and by applying Stokes's formula as in the original method. The charge e was determined by finding the change in the velocity when the force $Z.e$ and w acted together. In this method it was unnecessary to find the number of drops in the cloud. It was observed that the change in the velocity due to the electric force was not the same for each drop, since the cloud appeared to fall in groups of drops with charges in the proportion 1 : 2 : 3.

This important observation showed that the charge on a drop, if not equal to, was a multiple of the smallest charge. H. A. Wilson gave $3\cdot1\times10^{-10}$ as the value of the atomic charge according to this method.[7]

It is well known that the most accurate determinations of the atomic charge were made by Millikan in the period 1909–1916.[8] As it was unnecessary to find the number of drops in the cloud in order to determine e, Millikan applied H. A. Wilson's method to single drops. Inaccuracies due to evaporation were avoided by using drops of non-volatile oil, which were placed in electric fields of such strength that they could be made to move against gravity or held in suspension at will. A single drop could thus be kept under observation for long periods. He tested Stokes's formula, which had been assumed by his predecessors, obtaining an empirical correction to it in the case of small drops, and his very consistent results[8] showed that the charges carried by drops were always exact multiples of the atomic charge $4\cdot77\times10^{-10}$ E.S.U.

The earliest investigations of the atomic charge had an important bearing on the interpretation of the experiments made to determine the ratio of the charge e to the mass m of an electron. The first trustworthy determinations of the ratio e/m were made in 1897 by Wiechert,[9] Kaufmann,[10] and Thomson,[11] who found that the ratio e/m for cathode rays was about 1/2000 of the ratio E/M of the atomic charge E to the mass M of an atom of hydrogen. It was known from experiments on electrolysis that the ratio E/M was $2\cdot9\times10^{14}$ while the best experiments gave $5\cdot3\times10^{17}$ for the ratio e/m, and from the first it was suggested by Wiechert that the charges E and e were equal and consequently that the mass m was about $M/2000$. This suggestion, however, could only be regarded as a plausible hypothesis until the identity of the charges E and e had been established in 1899, in relation to which Townsend's investigation of the product $n.e$ ranks in importance with the accurate determination of the atomic charge e.

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[1] J. S. Townsend, *Proc. Camb. Phil. Soc.*, Feb. 1897.
[2] *Phil. Mag.*, Feb. 1898.
[3] J. J. Thomson, *Phil. Mag.*, Dec. 1898.
[4] *Phil. Mag.*, 1899.
[5] *Phil. Mag.*, March 1903.
[6] J. S. Townsend, *Phil. Trans.*, May 1899.
[7] H. A. Wilson, *Phil. Mag.*, April 1903.
[8] R. A. Millikan, "The Electron", University of Chicago Press, 1917.
[9] E. Wiechert, *Sitz. Phys. ökon. Ges. Königsberg*, Jan. 1897.
[10] W. Kaufmann, *Wied. An.*, July 1897.
[11] J. J. Thomson, *Phil. Mag.*, Oct. 1897.

Scientific and Industrial Research*

THE seventeenth annual report of the Department of Scientific and Industrial Research covering the period August 1, 1931–July 31, 1932, appears appropriately as if to punctuate the tributes to the importance of research in our national life which have recently been paid by high authorities in finance. A more impressive picture of the manifold ways in which scientific research is daily applied not merely to the solution of our industrial problems but also to the service of the innumerable needs of a civilised community than is contained in the annual reports of this Department it is difficult to imagine. The present report, including the brief report of the Privy Council, signed by the Right Hon. Stanley Baldwin, and the longer report of the Advisory Council, over Lord Rutherford's signature, is no exception to the rule. Lucid as are these reports and the summaries of the work carried out by the National Physical Laboratory, the Chemical Research Laboratory, the research associations, and under the direction of some forty-five research boards and committees, a popular exposition of the matter contained in them should be invaluable propaganda and assist the ordinary citizen to appreciate the magnitude of the contribution thus made to the necessities and luxuries of his daily life—food and clothing, air and water supply, transport and housing, business and pleasure. Appendices to the report deal with finance, publications and the personnel of the various boards and committees.

There is no department of State in which the beneficial influence of the Department of Scientific and Industrial Research is not felt and no proportion of the national income is more profitably spent than that controlled by this Department. *It is satisfactory to find that the expenditure* detailed in the current report shows only a slight reduction on that recorded in the previous report; the gross expenditure for the year amounted to £695,677 as compared with £740,520 in 1930–31, and the actual expenditure to £534,700 as against £555,691. Receipts showed a decrease from £184,829 to £160,977, most of which is represented by decreased receipts of the National Physical Laboratory from outside bodies and firms, Government departments, etc. The net expenditure on headquarters administration is £24,900, grants for research amounted to £34,398 net, and to research associations £82,307, an increase of £6,652 on the previous year. Expenditure on the Geological Survey and Museum amounted to £62,730, and on the National Physical Laboratory to £200,754 gross, against which receipts amounted to only £93,982 instead of £104,706 in 1930–31. The net cost of the Chemical Research Laboratory was £19,450, of radio research £10,482, of water pollution research £10,796, fuel research £82,707, receipts diminishing the gross expenditure on the latter by £6,033. The major part of the expenditure on food research is met by a grant of £30,502 from the Empire Marketing Board and this and other receipts bring the gross expenditure of £46,997 to £11,530 net. Similarly, receipts amounting to £7,680 and £7,896 reduce the expenditure on building and forest products research to £34,519 and £33,792 respectively.

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* Department of Scientific and Industrial Research. Report for the Year 1931–32. (Cmd. 4254.) Pp. iv+193. (London: H.M. Stationery Office, 1933.) 3*s*. net.

Nineteen research associations received grants during the year, and the report records that certain of these associations have been able to record a marked increase of industrial support during the past year while others are hopeful of attaining similar success in the near future. The British Electrical and Allied Industries Research Association now derives approximately one-half of its industrial income from supply undertakings, and the majority of lead manufacturers in the country are now members of the British Non-Ferrous Metals Research Association. Refractory material makers are supporting more strongly the British Refractories Research Association, and the voluntary levy scheme launched by the Wool Industries Research Association two years ago is now working smoothly but, mainly owing to bad trade conditions, has not yet shown signs of yielding an income sufficient to meet the Association's present scale of expenditure.

On the other hand, the British Cast Iron Research Association, in spite of the highly important and eminently practical research results to its credit, is experiencing great difficulties in maintaining its industrial income, while membership of the Cutlery Research Association has declined from fifty to ten firms in two years. In view of this lamentable lack of interest in the Association's investigations, the Department concluded that continued expenditure of the public funds at the disposal of the Association was unlikely to lead to results of benefit to the industry as a whole and, with the consequent surrender of these funds, *termination of the Association's activities* has been inevitably involved.

Reviewing the work of the research associations as a whole, the report emphasises the importance of their work to industries other than those designated by their respective titles and notes movements for widening the basis of industrial support. Few of the research associations appear to be in favour of a compulsory levy scheme, and accordingly the Advisory Council is unprepared at the present time to make representations in favour of introducing a general measure to authorise the compulsory adoption of a levy.

The general interest of the work of the research associations may be illustrated by a few typical examples selected from many to which space forbids even reference. In the iron and steel industry, research has reduced the consumption of coal per ton of finished steel from 31 cwt. in 1924 to 23 cwt. in 1930, representing an estimated average saving on coal used after the pig iron stage of more than £1,468,000 on the 1930 production. Important work on smoke abatement, refractories, etc., is being carried out in collaboration with other interests concerned. With the support of the water-supply authorities and others, the Non-Ferrous Metals Research Association has commenced a study of the bursting of water-pipes by frost by a thorough investigation of the properties at low temperatures of the materials used for them. The Association is also investigating the quality of galvanised iron with special reference to the corrosion of hot-water tanks and the retention of brightness of polished white metals, such as are used for shop fronts, name plates, etc. These are matters in which the ordinary citizen or householder is as interested as the industrialist, and the same may be said of investigations carried out by the Electrical and Allied Industries Research Association on conducting leads in gas-filled lamps used for office and factory lighting, which have enabled a considerable reduction in the rise of temperature in the fittings to be effected and simultaneously reduced the fire risk. The same Association has developed a simple portable apparatus for determining the conductivity of the ground along a proposed cable route, so that the correct size of cable required to carry the current can be ascertained. Other investigations have been concerned with the efficiency of electrical earthing and on the cause and prevention of interfering noises on telephone lines.

The Refractories Research Association provides a striking example of an association of which the work is of general interest, and closely associated with its investigations are representatives of the Institution of Gas Engineers, the National Federation of Iron and Steel Manufacturers and the British Pottery Manufacturers' Federation. These investigations have ranged over such subjects as the durability of refractory materials and its improvement, the permeability of refractory materials to high temperatures and changes in physical structure during the firing of fire clay goods.

The Research Association of the British Paint, Colour and Varnish Manufacturers has continued its investigations on the measurement of the physical and mechanical properties of paint, varnish, and lacquer films, the hiding power of paint, the relations between crystal structure, surface characteristics and pigmentary value. The recently formed Research and Standardisation Committee of the Institution of Automobile Engineers, to which the Department contributes financially, has occupied itself with problems of cylinder and piston wear, lubrication, and with such problems of general interest as silencing, for which a new instrument has been designed.

The Cotton Industry Research Association is not only carrying out important fundamental studies of dyestuff solutions, the dyeing process, and mercerisation, but has also made special efforts to demonstrate to its members the practical value of its operations. More than two thousand visits were paid to mills and works during the year by its liaison staff, and the prestige of the Association is distinctly greater in the trade than a year ago.

The Wool Industries Research Association has been concerned with the various causes of fading such as light and atmosphere, laundering and perspiration, which are often of immediate interest to the public. The Linen Industry Research Association has similarly been concerned with wearing properties under laundering as well as with levelness and regularity of weave. The Launderers' Research Association has been concerned with detergents as well as with the mechanical conditions, with the object of decreasing attrition and the prevention of felting of wool, etc.

Among the problems occupying the attention of the Leather Manufacturers' Research Association have been the deterioration of leather on storage, the factors responsible for dermatitis associated with dyed leather, while the Boot, Shoe and Allied Trades Research Association has designed new lasts on which the contracts for the Army marching boots are being carried out, using vegetable tanned leather curried according to the Association's recommendations. The sound-absorption of rubber flooring in auditoriums, improving the resistance of rubber to oils, ageing, and water absorption are directions in which the Rubber Manufacturers' Research Association is assisting the utilisation of rubber and the revival of this depressed industry.

The Research Association of British Flour Millers is investigating the blending of wheat to give flour of regular and improved qualities. The Research Association for the Cocoa, Chocolate, Sugar, Confectionery and Jam Trades has been concerned with such varied problems as the 'solubility' of cocoa, standardised specifications of, purity of materials, including wrappers, coatings of sugar crystal, while the Food Manufacturers' Research Association has carried out successful investigations on the canning of kidneys and liver as well as on the development of satisfactory gums and pastes for labels.

These investigations are, however, only a fraction of those concerned with food with which the Department as a whole has been concerned. The importance of food in the maintenance of health and in the control of disease is being more and more widely recognised in days when emphasis is laid on preventive as against curative methods. It would be difficult to overstress the importance to public health of some of the work which is being carried out to preserve the freshness of food. Merely to enumerate the investigations on the storage of chilled beef, opening up the prospect of chilled beef from Australia being marketed in Great Britain, on the storage of bacon and ham, on canning problems, on the smoke-curing of fish, on the preparation of fish livers for treating pernicious anæmia and on the storage of fruit and vegetables. should bring home to the most unimaginative citizen the value he receives from the expenditure of this insignificant proportion of the national reserve, even if its importance to home industries and to the shipping companies is less apparent.

The importance of the physical and chemical survey of the coal resources of Great Britain has been enhanced by the events of the last two years, and other work carried out under the Fuel Research Board dealing with the scientific utilisation of fuel, including low temperature carbonisation, represents an attack on perhaps the most crucial problem with which the Department is concerned, bearing directly on the unemployment problem as well as, through its reaction on atmospheric pollution, on public health.

Again, it is a simple matter for the ordinary citizen to appreciate the immense importance of the work of the Building Research Board outlined in this report, whether as applied to the testing of building materials, the weathering of materials, or the design of reinforced concrete piles for the foundations of big buildings, momentary stresses in which are now being measured by an ingenious application of radio methods. He will readily grasp also the significance of the researches on steel structures now so widely used in building, and the activities of the Radio Research Board, which are frequently as closely related to the needs of the ordinary listener and amateur as to those of the Post Office, the Admiralty, the War Office, the Air Ministry and other bodies at the request of which many of them were originated. The work of the Forest Products Research Board bears directly on the life of timber and the efficiency with which it can be preserved against insect or fungoid attack, whether by the death watch beetle for example or by dry rot, and once again touches many a householder closely.

To do justice to the activities of the National Physical Laboratory might well require volumes, and only a few examples can be given. In the William Froude Laboratory, research on wind resistance has indicated ways in which the air resistance of most types of vessel can be reduced by about 30 per cent, while other improvements have been effected in the design of small coaster vessels as well as in the humble barge, the improved design showing on towing tests a 33 per cent improvement in speed for slightly less power. The National Physical Laboratory played an important part in designing the high speed seaplanes which won for Great Britain the 1931 race for the Schneider trophy, as well as in the development of new and safer types of aircraft. Other work assists in the provision of improved materials for industry, including steel and steel alloys capable of withstanding the high temperatures at which modern machinery such as turbines and aircraft engines must work, and workers in other sections of the Laboratory again are investigating the glare effect of different systems of street lighting, the best beams for traffic control signals, the transmission factors of coloured railway signal lights and the lighting of docks, quays and their approaches. It needs little imagination to realise what advance in these fields means not merely to industrial efficiency but even more in the elimination of much suffering and loss of life.

The field covered by the work of the Chemical Research Laboratory is almost equally wide, ranging from products for treatment of sleeping sickness in human beings and in animals, to the preparation of synthetic resins, corrosion research, researches at high pressures, tar research and water pollution. With the latter subject a special board is concerned, and following on the survey of the River Tees recently carried out, one on the River Mersey is now projected.

Space does not permit further reference to many activities of the Department which are of scientific as well as of industrial and general interest. This brief review contains no account of important metallurgical researches for which the Department is responsible, or of its investigations on electrodeposition, lubrication or dental problems. Mention should, however, be made of the Geophysical Survey Research Committee, which has now completed its work and through the activities of which the danger that the development and use of this new applied science in Great Britain would be neglected has been dispelled. Sufficient has been said, however, to demonstrate the unique and invaluable contribution which the Department is making not merely to industrial efficiency but also to industrial development and the public welfare, and to indicate how essential it is in days when economy is the watchword that there should be no restriction of services which have been so productive.

Obituary

LIEUT.-COL. ALFRED W. ALCOCK, C.I.E., F.R.S.

WITH the death on March 24 of Alfred Alcock, there has passed away a type of doctor who in the past has so often graced the ranks of the Indian Medical Service—that of the surgeon-naturalist. Zoological science in India has been always enriched by the labours of distinguished medical men, of whom the late Sir Joseph Fayrer and Alfred Alcock may be taken as representing the acme of a period which will never be seen again.

Alfred Alcock was born in Bombay on June 23, 1859. His father, who was a sea captain in the days of windjammers, retired and lived at Blackheath, and there the subject of this memoir went to school and afterwards became a Westminster scholar. In the 'seventies, owing to ruinous losses due to the sudden depreciation of Egyptian Government bonds, he was taken away from school, in 1876, quite unexpectedly. He was then packed off in September of that year to Wynaad in the Malabar District of Southern India, to a coffee plantation, where he had an uncle engaged in this industry. He lived in the jungles of Wynaad and in the neighbouring native State of Cochin, and was able to observe all the operations connected with coffee-planting and also to study the birds and beasts.

As coffee planting was then obviously in the decline, Alcock obtained in September 1877 a post in a newly established firm of commission-agents in Calcutta, and on the voyage from Madras to Calcutta, the ship that carried him, the *Duke of Buccleuch*, was rammed and almost sunk by a steamer, appropriately named the *Vixen*. The commission-agent business not proving a success, he next started as a freight-broker on his own account, but soon gave that up to proceed to Chota Nagpur as an assistant to a coolie-recruiting agent, where he remained until February 1880. It is necessary to mention this, as in some ways it proved the turning point of his career, for he met there a young Bengal civilian who lent him Michael Foster's "Primer of Physiology", which cost the sum of one shilling, and this little book proved to him to be what the light of heaven was to St. Paul. It set his face towards natural science, and throughout the rest of his life he thought of Michael Foster (whom he had never met) with the gratitude of a disciple. He next met the Deputy Sanitary Commissioner of Chota Nagpur, Lieut.-Col. J. J. Wood, and this good man took the young Alcock to his heart and hastened him on his way with an old microscope, several timely books and many long talks on botany, natural history and chemistry. This led him to do a little body-snatching on his own in places where the poorer natives disposed of their dead, and from that source he obtained bones to study and began to read Darwin's "Descent of Man" and "Origin of Species". He had now fully resolved to become a medical man.

Alcock next became assistant schoolmaster at a large school for European boys in Darjeeling.

He was justified in applying for this appointment since during the whole of his jungle life he had assiduously read his Horace and his Homer along with the "Canterbury Tales" and the "Golden Treasury". Fate was kind to him, because his "sanitary friend", Col. Wood, immediately rejoined him in the Darjeeling district, and actually entrusted him with the tuition of his eldest boy. Quite unexpectedly, he was helped financially by his sister, who had married a distinguished officer in the Indian Civil Service, and was able to proceed to Aberdeen, to begin work in the Marischal College of that University. In 1882 he had taken first place in the class, and the medal for natural history, and was appointed University assistant in zoology. In 1883 he obtained a bursary in natural science, and in April 1885 he graduated M.B. and C.M. with honourable distinction, while later on in that year he passed eighth into the Indian Medical Service, and in October of the same year, he joined the class at Netley Hospital, where he came under the influence of the celebrated Timothy Lewis, the professor of pathology.

Alcock's interest in the beginnings of tropical medicine had already been stimulated by the lectures of Sir Alexander Ogston, the professor of surgery in the University of Aberdeen. Ogston had discerned the great significance of the discoveries made by Patrick Manson in China on insect-borne disease, and this had impressed itself so much on his mind that it remained a guiding factor for the rest of his life.

In March 1886 Alcock again sailed for India, and was first stationed at Allahabad, and on June 6 of that year he was ordered to join the 1st Sikh Infantry at Dera Ismail Khan on the Punjab frontier. There he found himself soon shot out into the Punjab desert, and had many interesting adventures, during one of which he crossed the desert of 150 miles in the middle of the hot weather, and on another occasion he had the misfortune to break his leg and lay for some time with only a native hospital assistant to look after him. In this desert he observed many cases of snake bite, some fatal, by the horned viper. His promotion was very rapid, and in May 1888 he was gazetted to permanent medical charge of the 2nd Punjab Infantry.

Regimental life had been an extremely happy experience to Alcock, but a regimental hospital did not quite satisfy his ambitions for scientific work, and soon an unexpected opportunity presented itself when he was appointed surgeon-naturalist to the R.I.M.S. *Investigator* for the zoological section of the Indian Marine Survey of 1888-92. He joined his ship at Port Blair in the Andaman Islands on November 20, 1888. These four years he regarded always as the happiest of his life, and his experiences were summarised in that fascinating book "A Naturalist in Indian Seas" published in 1902, and it was this book that obtained the highest commendation from Sir Joseph Hooker. During this time he roamed the coastal inlets and Indian Seas, dredging for Crustacea and describing the marine fauna, including many denizens of the deep hitherto unknown to science. During his travels he visited the Andaman Islands, the Cocos Keeling, Minicoy and other sparsely inhabited islands of the Indian Ocean, studying their human inhabitants and the island fauna.

In April 1893 Alcock began his association with the Indian Museum as professor of zoology in the Medical College of Bengal, and he served many happy years in this capacity until 1907. His period of service was broken in 1895 when he was appointed as surgeon-naturalist to the Pamir Boundary Commission, and spent one year at these alarming altitudes over 14,000 ft. He actually reached the tomb of Bazai at the eastern end of the Little Pamir. His report on the natural history results of the Pamir Boundary Commission was published in Calcutta in 1898, and received general recognition.

In 1896, after ten and a half years continuous service in India, Alcock returned to England on leave, and in July 1897 he married Margaret Forbes Cornwall of Aberdeen, whom he had known in his student days. In 1901 he was elected to the fellowship of the Royal Society and in 1903 was created a C.I.E.

There is no doubt that the finest work that Alcock performed in India was that of the organisation and rearrangement of the Indian Museum, which he made a model of its kind. It was here that he came under the notice of Lord Curzon, with whom he had some difference of opinion regarding the future of this Museum. He then made, too, a lasting and life friendship with Sir Leonard Rogers, and with him became greatly interested in the classification of the *Thanatophidia*, and collaborated with him on the toxicology of snake venoms. In the meantime, he had become the outstanding authority on the Crustacea of India, a group to which he had always paid special attention, and wrote the "Catalogue of the Indian Decapod Crustacea", a work for which he was awarded the Barclay medal of the Asiatic Society of Bengal in 1907. At this time he wrote numerous papers on the river crabs (Potamon dæ) and was elected natural history secretary in 1888, general secretary in 1895, and vice-president in 1901 of the Asiatic Society. In 1906 he was on furlough in England, working through the major's course for promotion at the Royal Army Medical Laboratories and at the West London Post Graduate School, and also the Lister Institute. Here he made the acquaintance of Sir William Leishman, Sir Jonathan Hutchinson and Sir Charles Martin.

In 1907 Alcock retired from the Indian Medical Service, and immediately placed himself at the services of Sir Patrick Manson and of his new School of Tropical Medicine in London. Here he felt like a new man after what he considered to be his sad failure at the Indian Museum. Manson was the magnet which drew him, and the foundation of medical zoology on a proper basis, was his aim. He became Manson's most faithful lieutenant and admirer; to him it was a pious task to defend Manson's reputation and to aid in preserving his memory, for, apart from all his discoveries and his greatness, he considered that Manson was the embodiment of the Hippocratic tradition. Henceforward he became the first teacher of medical entomology in the School of Tropical Medicine, and he added greatly to his reputation by the publication of his text-book, "Entomology for Medical Officers", 1912, which reached its second edition in 1920. This work was written in response to requests from students in his own School, and whilst directing its attention principally to the arthropods concerned in the dissemination of disease, it almost became an outline of zoology.

To thousands of post-graduate students of all nationalities, in his charming and unpretentious way, Alcock became guide, philosopher, and friend. Soon he became responsible for the foundation and establishment of the entomological collections of the School, and for the collection of poisonous snakes and other reptiles; in fact, the whole zoological fauna that make up the science of tropical medicine. He organised the Tropical Diseases Library of the School, and from 1912 onwards actively participated with Dr. A. G. Bagshawe in reviewing for the *Tropical Diseases Bulletin*, becoming the assistant director of the Bureau in 1921. He was very gratified in being elected in 1920 to the professorship of medical zoology in the University of London. His reviews of medical zoology, as indeed every letter and article he wrote, were characterised by a charming scholastic style, embroidered with a wealth of literary and classical allusions, which could scarcely be surpassed, and gave his work an air of great distinction.

Then came the War, and in his endeavours to serve his country, Alcock found himself appointed as surgeon to an Indian hospital at Brighton, but he found himself 'at sea' when armed with a scalpel, and instead devoted himself to instructing R.A.M.C. officers, proceeding overseas, in the elements of tropical medicine. The War being over, he returned to his active teaching, and in the following years he collaborated with Dr. P. Manson-Bahr in "The Life and Work of Sir Patrick Manson", which was published in 1927. He was thus afforded an opportunity of making clear the everlasting truth of medical biology as evidenced by the life story of Manson.

Alcock retired from active teaching in 1924, and had been living in seclusion at Belvedere in Kent, but in no wise did his zeal for his favourite subject abate.

It is scarcely necessary to enlarge further on his character—that of the true naturalist, and man of science, and a lover of his fellow creatures—in fact, a friend of all mankind. It was a common experience for a stranger on seeking his road in far away Belvedere to Alcock's house, to inquire the way of some whistling schoolboy, and to receive as an astonished reply, "Oh, that's where Col. Alcock lives; he is a great pal of mine." It is appropriate to quote his favourite lines:

> "Nature is made better by no mean,
> But nature makes that mean; so, over that art
> Which you say adds to nature, is an art,
> That nature makes—The art itself is nature."

His philosophy of life, like that of old Pittacus, of Mitylene, was: "The greatest blessing a man can enjoy is the power of doing good." So, when he is gone, we realise that the era of the pioneers of tropical medicine is closed.

Alcock was an LL.D. of the University of Aberdeen, and a corresponding member of the Zoological Societies of London and of the Netherlands, and also of the California Academy of Sciences.

DR. JOHN BELLING

DR. JOHN BELLING, elder son of the late John Belling, inspector of Army Schools, who died on February 28 in San Francisco, was born at Aldershot, England, on October 7, 1866. He taught in various schools, attending lectures meanwhile at London and Birmingham, and obtained a London B.Sc. (Hons.). In later life he was given the honorary degree of Doctor of Science by the University of Maine in 1922. He lectured in the Horticultural College at Swanley, England; and later at Llanidloes, Wales, in 1900–1. Shortly after this he went to the British West Indies where he became investigator in the Department of Agriculture. In 1907 he went to the Florida Experiment Station as assistant botanist and carried out important researches there on hybrid beans.

Shortly after the War, Belling went to the Carnegie Institution of Washington as cytologist in the Department of Genetics, and was associated with Dr. A. F. Blakeslee in the investigation of the chromosomes of *Datura*. Here his genius in microscopy and his philosophical insight opened up a new field in the study of the behaviour of chromosomes and in the interchange of segments between non-homologous chromosomes. Belling was subject to periods of depression during which he did some of his most brilliant work. Believing that it was important for him to have a change of scene, he was transferred by the Institution to Berkeley, California, where he worked in a corner of Prof. E. B. Babcock's laboratory, continuing his fundamental researches on the structure of chromosomes in hyacinths and various lilies. In these investigations, under superlative technique, he believed he was able to see structures, which on account of their number and size, he identified with genes.

Belling was the author of a book on the use of the microscope, which has been eminently successful. He had also made considerable progress with a work on the study of the chromosomes.

After the Sixth International Congress of Genetics, held in Ithaca last summer, a number of foreign delegates travelled to Berkeley to examine Belling's preparations showing the structure of the chromosomes, and to discuss with him his interpretations of them. He was also the author of a small book of verse, "The Life-World. Poems of Science" (published by the Margaret Mary Morgan Co., 619, California Street, San Francisco). It contains sixty poems concerning scientific (chiefly genetic) phenomena and also three others, the last of which, "Elegy", is of exceptional beauty.

Belling married Miss Hannah Sewall, who died in 1926 without issue. He is survived by a brother, James Belling, residing in the Cheltenham district, also by a sister, Miss Annie Belling.

PROF. E. C. STARKS

WITH the passing at a comparatively early age of Prof. Edwin C. Starks, American ichthyological science has suffered yet another grievous loss, following, as it does, close upon the deaths of David Starr Jordan, Charles H. Gilbert, Carl H. Eigenmann and Barton Warren Evermann. Thus, within a comparatively few years the five zoologists, who, with Theodore N. Gill (1837–1914), may be said to have dominated the study of fishes in the United States during the last half century, have died.

Prof. Starks was born at Baraboo, Wisconsin, on January 25, 1867, studied at Stanford University from 1893 until 1897, and was then appointed assistant to the United States Biological Survey. From 1899 until 1901 he held the position of curator and assistant professor of zoology at Washington (Seattle). In 1901 he returned to Stanford University, being appointed curator in 1901, assistant professor in 1908 and associate professor in 1927.

A list of Starks's published works on fishes, including those in which he collaborated with Jordan, Gilbert and others, would contain some seventy or more titles. Many of these were of a systematic nature, and included the results of an ichthyological survey about the San Juan Islands, Washington, the fishes of Panama Bay (with Gilbert), and the fishes of Puget Sound (with Jordan). In collaboration with Jordan he was responsible for an important series of revisions and monographs of Japanese fishes published between 1901 and 1906. By far the most valuable of his contributions to ichthyology, however, were the series of papers dealing with the osteology and affinities of various groups of bony fishes. These papers, with their careful descriptions and well-drawn illustrations, furnish a monument of accurate and painstaking research, and are invaluable to students of fish taxonomy.

J. R. N.

WE regret to announce the following deaths:

Prof. E. W. Hobson, F.R.S., formerly Sadleirian professor of pure mathematics in the University of Cambridge, on April 18, aged seventy-six years.

Sir Edward Rigg, C.B., C.V.O., who was appointed assistant assayer in the Royal Mint in 1873 and was superintendent of the Operative Department from 1898 until 1918, on April 14, aged eighty-three years.

News and Views

Rubber Industry Bill

IN the House of Commons on April 11, Mr. H. Williams asked the president of the Board of Trade whether he was aware that the Research Association of British Rubber Manufacturers had discharged many of its staff and suspended research work for lack of funds. (This matter was referred to in a leading article in our issue of February 11.) Mr. Williams asked further whether, in the circumstances, facilities would be given for further progress of the Rubber Industry Bill. Mr. Runciman stated that he was aware of the situation. He said: "The Government recognise that it is desirable that the work of this Association should continue and have decided to give an opportunity for further discussion in Parliament of the Rubber Industry Bill." Owing to pressure of business in the House of Commons, it is proposed to introduce the Bill at an early date in the House of Lords.

Improvement of Beef Cattle in Australia

IF, as predicted by Dr. J. B. Orr, Australia is to become "the stock farm of the Empire", one of its urgent needs is the improvement of the beef cattle breeds in the northern tropical parts of Queensland, North Australia and Western Australia. The handicaps to British breeds are sparse fodder and prevalence of ticks and tick fever. The success reported to have followed the introduction of Brahman (Zebu) strains into herds in poorly grassed, tick-infested territories bordering on the Gulf of Mexico induced the Australian Council for Scientific and Industrial Research in 1931 to make a close investigation of the actual position. As a result, it has for some time strongly advocated experimental breeding in Australia to evolve a suitable cross for the north between British and Brahman cattle. Lack of funds prevented immediate action, but four pastoral companies have now made sufficient money available to ensure a thorough test of the possibilities of the cross. An officer of the Council is in the United States selecting suitable animals (probably eight bulls and two cows) which will be shipped to Australia and, after compliance with exacting quarantine conditions, will be divided amongst the properties of the companies, which at present carry chiefly shorthorns and Herefords. All breeding and culling will be under the sole supervision and control of the

Commonwealth Council for Scientific and Industrial Research. Many years will be required for the evolution of an animal suitable for northern tropical conditions but success, if attained, will be of considerable importance to many parts of the Empire.

Coloration Problems in Animals

ALL who are concerned with the problems raised by the coloration of animals will be interested in the announcement that two hog-deer (*Cervus porcinus*) have just been born at the Gardens of the Zoological Society of London. This animal, of about the size of a roe-deer, has a more or less conspicuously spotted coat in the summer, and one of a uniform brownish hue speckled with white in the winter. But the young are heavily spotted, as with our fallow and red-deer, the spots serving to form a 'concealing' coloration. Another coloration problem, and in a way yet more interesting, now presents itself in the sixteen flamingoes just purchased and sent to the Society's park at Whipsnade. These birds lose much of the brilliance of their pink coloration in captivity. Careful note should therefore be made of the intensity of pigmentation of the new arrivals. It has been stated that birds in the London Gardens recovered their lost brilliance when they were turned out into a paddock affording free access to a large pond, well-stocked with small crustaceans. In the gardens of the New York Zoological Society an interesting experiment was made, years ago, on the beautiful rosy flamingo (*Phœnicopterus ruber*) which, in successive moults during captivity, became paler and paler, and finally almost white. By mixing a harmless dye with the food the fading process was considerably lessened, while some retained their original full colour for years. What was the 'harmless dye', and was it continuously administered? Under the more favourable conditions at Whipsnade, perhaps these birds may breed. In this event a valuable opportunity will be furnished to mark the effect, if any, of climatic influence, and food, on the coloration in their progeny.

Australian Sector in the Antarctic

THE Australian National Research Council is very much gratified at the announcement that an Order in Council has been issued by the British Government affirming that His Majesty the King has sovereign rights over the antarctic territory, other than Adelie Land, south of lat. 60° S., between long. 160° and 45° E., and placing such territory under the authority of the Commonwealth of Australia from the date on which the necessary legislation is passed by the Commonwealth Parliament. Seven years ago, during the presidency of Sir David Orme Masson, the Research Council urged that sanction be sought for Australian administration of that part of the continent between long. 160° and 90° E. The matter was discussed at the Imperial Conference in 1926 when it was placed on record that there were certain areas to which British title existed by virtue of discovery. More thorough exploration of this 'Australian sector' was, however, obviously desirable and to that end the Governments of Great Britain, Australia and New Zealand, with liberal financial aid from Sir MacPherson Robertson of Melbourne, fitted out the "Discovery" expeditions under Sir Douglas Mawson in the seasons 1929–30 and 1930–31. These explored the greater portion of the sector between long. 160° E. and 45° E. including Enderby Land, Kemp Land, Queen Mary Land, King George V Land and new areas to the east of Kemp Land which were named MacRobertson Land and Princess Elizabeth Land. Australia will now presumably assume a measure of responsibility for developing and regulating existing and possible industries in the sector, including the enforcement of the International Convention on Whaling.

International Cloud Photography

THE intensive international study of meteorology during the Second International Polar Year, 1932–33 includes also the sky, and General Delcambre, president of the International Commission for the Study of Clouds, selected two periods for specially detailed investigation in France and neighbouring countries. The first was on April 12 and 13, while the second is arranged for July 12 and 13, 1933, and General Delcambre has asked for material from England. Should conditions on July 12 and 13 be suitable, meteorologists with cameras are asked to take at least three cloud photographs each day, as near as possible to the hours of 8 a.m., 2 p.m. and 7 p.m. B.S.T., and others at intermediate hours whenever the general character of the sky changes. The purpose of the photographs is to represent the changes of the sky as a whole, and cloud-systems should be photographed rather than individual clouds, using, for preference, a wide-angle lens. Artistic merit is a secondary consideration; the prints should show as much detail as possible, but should not be re-touched. Filters should be used if necessary to bring out the structure. It is important that the following information should be given on the back of each print: name and address of the photographer, place where taken, date and time. It is desirable also that notes should be added as to the fraction of the sky covered by cloud, the nature of the clouds in the part of the sky not included in the photograph, the direction in which the camera was pointing and the approximate elevation above the horizon. Prints, suitably packed, should be addressed to: M. le Ministre de l'Air, Office National Météorologique, 196 rue de l'Université, Paris 7, and in the corner should be written "Année des Nuages".

Trevithick Centenary Commemoration Programme

THE centenary commemorations of the death of Richard Trevithick will be held on April 22, 23 and 24. On Saturday afternoon, April 22, a demonstration will be held at Camborne, where Trevithick made his first experiments with a steam road carriage, and on Sunday afternoon a memorial service will be held in the Tregajorran Methodist Chapel, in the parish of Illogan, Cornwall, his birthplace. On Sunday morning a memorial service will be held at 11 a.m. in Dartford Parish Church, Kent, where the preacher will be the Right Rev. the Lord Bishop of Rochester. At the close of this service an address on Trevithick will be given by Mr. L. St. L. Pendred, and a wreath will be placed on the memorial which recalls Trevithick's death at the Bull Inn, Dartford, on April 22, 1833. At evensong at 3 p.m. in Westminster Abbey on Sunday, special reference will be made to the centenary by the preacher, the Ven. Archdeacon V. F. Storr, and at the end of the service a chaplet will be placed beneath the Trevithick window in the north aisle of the Abbey. Finally, on Monday, April 24, at 6 p.m., a memorial lecture will be delivered by Prof. C. E. Inglis, at the Institution of Civil Engineers, Great George Street, S.W.1, by kind invitation of the Council. The chair will be taken by Sir Murdoch Macdonald.

Unemployment and the Schools

At the National Union of Teachers' annual conference on April 15 the new president, Mr. H. N. Penlington, of Hemsworth, Yorkshire, opened his address with the declaration that unemployment is the outstanding problem of our age; and this *leitmotif* dominated the rest of his discourse under the headings of school objectives, school buildings and school staffs. With the ever-increasing displacement of human labour by machinery, leisure seems destined to bulk more and more largely in human life, and it follows that preparation for life must increasingly include equipment for commendable uses of leisure. Unemployment in the building trade could be substantially relieved by carrying into effect school building programmes in respect of more than fourteen hundred schools which are admittedly insanitary or in other ways totally unfit for their purpose. Not less urgent is the need of relief of overcrowding of classes, in nearly eight thousand of which the enrolment exceeds fifty pupils. Meanwhile, the number of unemployed teachers grows and is expected to reach between two and three thousand by September next. If the school-leaving age should remain unchanged, the number of 'school-leavers' this year will be about half a million—an exceptionally large number—and a large proportion of these must go to swell the numbers of the unemployed. The time is opportune, Mr. Penlington suggested, for raising the school-leaving age, and he emphasised the dangers of an unenlightened and reactionary policy spreading discontent, already rife, on account of the 'cuts' in the Burnham scales.

Herrings and the Origin of Petroleum

It would seem at first a far cry from a modern herring catch to petroleum genesis, but a recent discovery off the coast of Alaska proves this to be by no means the case. Some twenty or thirty years ago a boat loaded with herrings was wrecked off Admiralty Island, Alaska, and recently samples of the sea deposits, near to where the wreck occurred, were dredged up and sent to the United States Geological Survey in order that an analysis could be made of an unusual waxy substance which they contained. The investigation was in charge of Dr. R. C. Wells of the Survey, who proved that the wax was a complex compound formed of decomposition products of the fat in the fish, combined with calcium and magnesium salts of the sea-water. It was further found that high-temperature distillation of this wax gave rise to an oil having affinities with petroleum. In all theories of organic origin of petroleum the most difficult part to understand is precisely how the original substance underwent conversion into the hydrocarbon oil which we recognise in crude petroleum and, while we may visualise the environment under which these changes took place, the actual chemical mechanism involved is far more difficult to conceive.

As a report issued by Science Service (Feb. 14) states in connexion with this matter, the fact that the fatty acids formed by decomposition of the fish united into a complex waxy salt with minerals in the sea-water suggests that something of the same sort may have happened in the ancient seas in which petroliferous deposits have been laid down. The only criticism we have to make in this instance is that practically all scientific evidence available tends to show that the time factor is of fundamental importance in the production of petroleum, quite apart from the environment in which it may have been conceived. In this particular illustration, it would seem that comparatively little fundamental change could have taken place in the organic substance deposited by this wreck, and we question whether the results of distilling this wax-like material are really indicative of more than would be expected from interaction between animal substance and sea salts, interactions which must, in point of fact, be constantly in process in every sea and in all kinds of environments.

Mechanical Transport in India

During the last forty years, railways have been a great boon to India, but now their practical monopoly is being seriously challenged by vehicles propelled along roads by internal combustion engines. The paper read to the Indian Section of the Royal Society of Arts on March 10 by Col. F. P. Barnes on the development of mechanical transport is therefore a timely one. He computes that the number of motor vehicles in India is about 160,000 and is rapidly increasing. But this only gives 1 vehicle for every 2,000 inhabitants. This compares with 1 in 5 in the United States and 1 in 32 in Great Britain. There is thus plenty of room for development. Amongst the advantages of motor transport are that it employs a large number of people, it adds to the amenities of life and has a civilising effect. It now gives employment to about 200,000 people in India. Instead of using the tonga and bullock wagon, the business man uses a car and can cover a much larger area in a much shorter time. He can also send his family to the hills in comfort. The civilising effect is shown in Waziristan, where a great circular road has been constructed running through a country of tribesmen who, a few years ago, were formidable enemies of the British. The road was largely constructed by men who had fought against the British and some of them are now employed as policemen to patrol it. Many passengers now leave their rifles at home, showing that law and order is being established. Col. Barnes pointed out the great advantages that would accrue to the railways if the motor industry were developed so as to feed and not to compete with them. Mechanical transport in India has received little encouragement from the Government. It has been mainly regarded as a source of extra revenue and heavily taxed. Despite this, it has flourished and is now one of the principal industries in the country. There can be little doubt that if it is encouraged, there will be a great future in India for mechanical transport.

Meteor Crater, Arizona

THE *Meccano Magazine* for March contains an illustrated article on this unique formation. The photographs give a vivid idea of the force of the impact, which shattered the rocks, and forced up great blocks of limestone. Mr. D. M. Barringer has for many years been making efforts to discover the meteor itself. Two vertical shafts were sunk near the centre of the crater, but there was no success, and the work was impeded by the influx of water, which turned the powdered rock-flour into a quicksand. Eventually experiments on the impact of projectiles led to the conclusion that oblique impacts give a nearly circular depression; Mr. Barringer had at first assumed that the meteor would lie under the centre of the pit, but further examination of the shattered rocks suggested that it had come from the north and was likely to lie under the southern edge of the pit. A shaft is now being sunk in undisturbed soil a quarter of a mile to the south of the pit; this will be continued to a depth of some 1,400 ft., and then a horizontal shaft will be run to the north, in the hope of encountering the meteor, which may be either a single great metal mass (in which case it is estimated to weigh some ten million tons) or a compact swarm of smaller masses. There is still some trouble from water, but it is hoped to overcome this by surrounding the shaft with reinforced concrete. Mr. Barringer has now been carrying on his arduous exploration for many years, and certainly deserves success. The article makes some estimates as to the date of the impact; it cannot be less than seven centuries ago, from the evidence of old trees growing on the rim; and it is thought to be less than five thousand years ago, from the fact that little erosion of the scattered blocks has taken place. Also the native Indians have a vague tradition of a fiery descent from heaven. Probably it may be dated between one and two thousand years ago.

Mind as a Living Process

THE second of the L. T. Hobhouse Memorial Trust lectures was given by Dr. Charles S. Myers on May 19, 1932, and has been published under the title of "The Absurdity of any Mind-Body Relation" (Oxford University Press. 2*s*. net). Dr. Myers maintains the view that any relation between mind and body is absurd because mental activity and living bodily activity are identical. The mechanical principles of the natural sciences are only an abstraction from the quasi-dual set of principles—direction and mechanism—that govern the entire universe. Each is an abstraction from the whole activity. Mind and life are identical properties of living matter, which differs from lifeless matter in its inherent, purposive, self-directive, and finally purposeful struggle for existence. From this point of view then, the hypotheses of psycho-physical parallelism, of interactionism, and of either form of monism are untenable. Dr. Myers quotes with approval from Hobhouse to the effect that life arose not from dead elements, but from pre-material elements which also gave rise to inanimate matter, so that all life contains a germ of mind. Mind is thus to be regarded as the expression of the directive activity of living matter. This directive activity is to be regarded as the highest unitary activity of the nervous system: the lower directive activities may not always be in harmony with the highest and hence the mental conflicts, conscious and unconscious. Dr. Myers discusses the relation of the cognitive, affective and conative aspects of experience and the part played by instinct and intelligence. The point of view is most lucidly expressed and raises interesting questions for philosophy, psychology, biology and physical science. It is worthy of note that ancient and medieval thought realised the problem also, and that only from the context in many writings can one know whether the word 'anima' is to be translated life or mind.

Origin of the Irish Flora and Fauna

IN his presidential address delivered last November to the Royal Irish Academy, Dr. R. Lloyd Praeger returned to a subject which has occupied his attention for forty years—the problem of the Irish flora and fauna (*Proc. Roy. Irish Acad.*, **41**, 125). The problem has been much discussed, but always with an obscurity of background due to absence of fossil evidence which might give the clue to the routes and periods of past immigrations. In such circumstances conclusions assume a personal interpretation and Dr. Praeger's view is that much of the present flora and fauna reached Ireland over land-surfaces, either during inter-glacial (Aurignacian) times, or in the same way after the ice had finally passed away, or probably during both periods. Certain plants and animals found with these immigrants, including the American and probably the Lusitanian element, are older than these, and survived the main glaciation. These oldest elements migrated northward in pre-glacial times along the western European coast line, or eastward from America when the intervening barriers of sea were at least much less formidable than they are at present.

Migration of Red Grouse

THE University of Aberdeen inquiry into the movements of the red grouse would welcome the co-operation of owners or tenants of grouse-moors willing to ring young or adult birds during the present season. Rings, with instructions for their use, may be obtained from Prof. James Ritchie, Marischal College, Aberdeen.

Economic Minerals

THE third number of *Sands, Clays and Minerals*, a new quarterly magazine devoted to economic minerals, contains a series of articles covering a varied and attractive field. Particularly noteworthy is a paper on British coals by Mr. A. L. Curtis in which a wealth of interesting information on the origin, composition and classification of coals and related materials, such as graphite, jet and peat, is gathered together. This is effectively illustrated by a beautifully produced coloured plate showing typical hand-specimens of fourteen of the materials dealt with. Other articles describe raw materials such as sands, tripoli powder, and sapphire (with two plates of rough and cut stones); research methods involving the application of ultra-violet light, elutriation, magnetism and heavy liquids; the mining of china clay, the properties of refractory cements, the decay and restoration of building stones, and the sources and uses of tantalum and niobium. The magazine is likely to be of great service to technical and commercial men who are interested in mineral products but may not have the time or opportunity to follow the more specialised literature. It is published by Mr. A. L. Curtis, Westmoor Laboratory, Chatteris, the annual subscription being 5*s*.

Researches on Cacao

THE first annual report on cacao research in 1931 carried out by the Imperial College of Tropical Agriculture, Trinidad, has just been published. Founded in 1922, the first years of the life of the College were necessarily occupied in academic duties, and although cacao was included in the scheme for long-range research work in 1927, it was not until 1930, when contributions from the cacao-producing Colonies and some of the manufacturers in Great Britain allowed of the purchase of a small estate and the recruitment of three special research officers, that any large development in this side of the work took place. The report deals with the results of the first year's investigations and it is a tribute to the College that so much fundamental information should have been gained in such a short time. On the botanical side, the problem has been approached from three main aspects, namely, propagation studies, genetical survey and studies of fruitfulness, and it is proposed to continue the work on similar lines in the future. The chemical and ecological section has begun an environmental study of the cacao tree and has carried out a soil survey of the Gran Couva district with a view of determining how soil types and environment affect productivity. Both growers and manufacturers alike should profit from the improved yield and quality in the crops, which there is every hope will result from these investigations. The report, price 1*s*., may be obtained on application to the Editor of *Tropical Agriculture*, Imperial College of Tropical Agriculture, Trinidad, British West Indies.

Deaf and Dumb in England and Wales

THE National Institute for the Deaf has issued a memorandum commenting upon a report by the late Dr. Eichholz to the Minister of Health and the President of the Board of Education on "A Study of the Deaf in England and Wales, 1930 to 1932". It is considered that the proposals contained in the report are inadequate to meet the needs of the deaf and dumb and of those who become deaf through disease or accident. Disappointment is expressed with regard to some of the proposals, and suggestions are made which it is considered would better the position, though it is realised that it may be impossible at present to incur fresh expenditures upon the work necessary to ensure the well-being of these classes.

Bibliography of Earthquakes

THE Dominion Observatory at Ottawa has continued its useful work by publishing a list of one hundred memoirs on earthquakes received during the third quarter of 1932. With very few exceptions, the memoirs belong to the last two years. All the principal countries in which earthquakes are studied are well and uniformly represented, a result that is no doubt due to the appointment of collaborators in Italy, France, England, Canada, Japan and Germany, as well as in various parts of the United States.

New Air Speed Record

WARRANT OFFICER FRANCESCO AGELLO, of the Italian Air Force, set up a new air speed record on April 10, when he attained an average speed of 423·76 miles an hour. Agello was flying a Macchi-Castoldi 72 seaplane at Desenzano, Lake Garda, and it is stated that on one run he reached a speed of more than 430 miles an hour. The machine was one of those originally intended for the Schneider trophy race of 1931. The previous record, 408 miles an hour, was set up on September 29, 1931, in a Vickers-Supermarine *S 6B* seaplane flown by Flight-Lieut. G. H. Stainforth.

New Director of the U.S. Bureau of Standards

IT is announced by Science Service, Washington, D.C., that Dr. Lyman J. Briggs has been appointed director of the U.S. Bureau of Standards, in succession to Dr. G. K. Burgess, who died on July 2, 1932. Dr. Briggs has been chief of the Division of Mechanics and Sound of the Bureau since 1920. He has carried out much research on aerodynamics, gyroscopic stabilisation and properties of liquids. He is the co-inventor, with Dr. Paul R. Heyl (also of the Bureau of Standards), of the earth inductor compass that is now widely used in aircraft. For this invention, Drs. Briggs and Heyl shared the Magellan fund and medal, awarded by the American Philosophical Society for "the best discovery or most useful invention relating to navigation, astronomy, or natural philosophy".

Sectional Meeting of World Power Conference

THIS year the World Power Conference sectional meeting will be held in Scandinavia, on June 26–July 8. Everyone interested in the energy problems of large industrial undertakings is cordially invited to take part. The Conference opens at Copenhagen on June 26. The members next proceed to Stockholm by special sleeping-car trains, where the opening address will be given by the Crown Prince of Sweden. A number of very attractive tours has been arranged, including one to Finland by aeroplane or boat. The closing session will be held in Oslo on July 8. The Conference Bureau will assist those who desire to pay a visit to any holiday resort. A large number of rooms have been reserved in the smaller hotels at prices which are stated to be far below the usual Continental level. The exchange also is in favour of sterling. Further details can be obtained from the offices of the World Power Conference, 63 Lincoln's Inn Fields, London, W.C.2.

Fifth Pacific Science Congress

AT the invitation of the Government of Canada and under the auspices of the Canadian National Research Council, the Pacific Science Association will hold the fifth Pacific Science Congress, for the study of Pacific problems, in Victoria and Vancouver, B.C., Canada, on June 1–14. It is expected that some thirty countries bordering on the Pacific Ocean will be represented at the Congress by four to six hundred men of science. The president of the Executive Committee of the Congress will be Dr. H. M. Tory, president of the National Research Council of Canada and director of the National Research Laboratories. The Congress will open at Victoria on June 1, where sessions will be held until June 3. On June 4, it will proceed to Vancouver, where further sessions will be held until June 14. A post-Congress tour has also been arranged from June 14 until June 19, when it will terminate at Calgary. The Congress will work in two divisions: Biological Sciences, under the chairmanship of Prof. C. McLean Fraser, professor of zoology at the University of British Columbia, Vancouver, and Physical Sciences, under the chairmanship of Prof. R. W. Brock, professor of geology and geography at the University of British Columbia. The secretary of the Congress is Mr. S. J. Cook of the National Research Council, whose address, in connexion with the Congress, is Hotel Vancouver, Vancouver, B.C., Canada.

Announcements

THE King has been pleased to appoint Sir William Cecil Dampier, fellow and sometime senior tutor of Trinity College, Cambridge, to be one of the Development Commissioners, in succession to the late Mr. Vaughan Nash.

BY an order of the Committee of Privy Council, Sir Thomas Lewis, director of the Department of Clinical Research in University College Hospital, London, has been appointed a member of the Medical Research Council in succession to Prof. J. J. R. Macleod, regius professor of physiology in the University of Aberdeen.

THE Melchett Medal for 1933 of the Institute of Fuel has been awarded to Sir John Cadman, chairman of the Anglo-Persian Oil Co., Ltd., and the Iraq Petroleum Company. The medal is an annual award for "original research or professional, administrative, or constructive work of an outstanding character, involving the scientific preparation or use of fuel."

IN view of certain changes in the administration of the Ministry of Agriculture of Brazil, the Directoria de Meteorologia will henceforth be entitled the "Instituto de Meteorologia, Hidrometria E Ecologia Agricola". Mr. R. P. Xavier retired from the position of director of the Brazilian Meteorological Service on March 6, and has been succeeded by Mr. C. de A. Martins Costa.

IT is announced by the Paris correspondent of the *Times* that the French Government has created a chair of mathematical physics at the Collège de France for Prof. A. Einstein. Special legislation was necessary and a Bill was prepared by the Ministry of Education and passed rapidly through the necessary stages in the Chamber of Deputies before the Easter recess. A few days earlier, the Madrid correspondent of the *Times* stated that the Spanish Minister of Education had announced the acceptance by Prof. Einstein of a chair in Spain and that, while the Government had made no precise conditions, it was thought Prof. Einstein would go to Madrid.

THE forty-fourth Congress of the Royal Sanitary Institute will be held at Blackpool on June 17–24, under the presidency of the Right Hon. Lord Cozens-Hardy. The Congress will be divided into the following sections: Preventive Medicine; Architecture, Town Planning and Engineering; Maternity, Child Welfare and School Hygiene; Veterinary Hygiene; National Health Insurance; Hygiene of Food. Conferences of representatives of sanitary authorities, medical officers of health, engineers and surveyors, sanitary inspectors and health visitors will also be held in connexion with the Congress. Particulars can be obtained from the secretary of the Institute, Mr. J. W. Dudley Robinson, 90, Buckingham Palace Road, S.W.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A junior assistant in the surgical unit of the Welsh National School of Medicine (University of Wales), The Parade, Cardiff—The Secretary (April 25). A lecturer in civil engineering and building at the Portsmouth Municipal College—The Registrar (May 5). A dairy bacteriologist in the Department of Agriculture and Horticulture of the University of Bristol—A. W. Ling, Agricultural Advisory Office, 22, Berkeley Square, Bristol 8 (May 6). An assistant lecturer in engineering at the Cardiff Technical College—The Director of Education, City Hall, Cardiff (May 6). A lecturer in electrical engineering at the Chelmsford School of Art and Technology—The Clerk to the Governors (May 8). A lecturer in pathology to dental students in the University and pathologist to the Queen's Hospital, Birmingham—The Secretary, The University, Birmingham (May 15). A demonstrator in physiology at St. Thomas's Hospital Medical School (University of London)—The Dean of the Medical School (May 27).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Remarkable Optical Properties of the Alkali Metals

I DESCRIBED in the *Philosophical Magazine*, about fifteen years ago, the high transparency for ultra-violet light of thin films of sodium and potassium, deposited by condensation at liquid air temperature, and their complete opacity for visible light. A resumption of the work has brought out some extraordinary properties.

A film of potassium, several wave-lengths in thickness, through which the sun is quite invisible, transmits about 25 per cent of the light included in the spectrum range 3000–1860 A.; the reflecting power from 3000 A. to 2700 A. is about 75 per cent, which means that practically no energy is absorbed, thick and thin films having equal transmitting power in this region. Below 2700 A. the reflecting power falls off very rapidly, soon reaching a value less than that of the bulb of fused quartz. But the most remarkable property is that interference bands are found in the spectrum of the reflected light. An end-on hydrogen tube was used as a source, and the film thickness increased by small steps, a spectrum being taken for each thickness. The dark bands entered from the short wave-length side and accumulated in the spectrum, orders so high as the fifth recording before the opacity became too great.

The filament of a tungsten lamp was invisible through a film which gave only two orders, the transmission of visible light being less than 1/100,000. Films of more than double this thickness gave very distinct interference bands, which means that the ultra-violet light, after two transmissions through the film, has still sufficient intensity to interfere with the light reflected from the first surface. The interference bands cannot be driven into the region above 2700 A., as the reflecting power of the first surface is too high to permit of interference, the bands being found only in the region of low reflectivity. In this region potassium has optical properties resembling those of selenium and the aniline dyes, the conducting electrons appearing to be without influence.

It seems probable that it will be possible to determine the dispersion in this region by the direct observation of the Brewsterian angle of polarisation, and experiments are now in progress along this line. All the alkali metals have now been examined, the transmission region moving down the spectrum as we pass from cæsium to lithium.

With cæsium the transmission band begins at about 4300 A., the films appearing of a blue-violet colour by transmitted light, of a purity equal to that shown by a strong solution of cuprammonium or dense cobalt glass. The film thicknesses are being determined by depositing a circular patch on the inner wall of a bulb, measuring its opacity to visible light and then opening the bulb and determining the amount of metal by titration with phenolphthalein. Experimental determinations of n and κ by the customary methods of metal-optics will be commenced shortly for the region of high reflecting power.

In the earlier work, it was reported that these films were unstable at room temperature, breaking up in a few minutes into globules and becoming almost perfectly transparent. I now find that if the quartz bulb is thoroughly out-gassed before the metal is distilled into it, the potassium films are permanent for several days, especially if moderately thick. A thin-walled quartz bulb with such a film makes a very useful filter for spectroscopic work; the sun's disc is invisible through it, yet we can photograph the solar spectrum through it with an exposure of only about four times normal exposure, the spectrum extending from a little above H and K to the extreme end. The transparency of such a film is nearly uniform as far down as the aluminium line 1862 A., and the lower regions are now being examined with a vacuum spectrograph.

R. W. WOOD.

Johns Hopkins University,
Baltimore.
March 20.

March 28.—Supplementing my letter of March 20 on the remarkable optical properties of the alkali metals in the ultra-violet region, I am now able to state that my prediction that potassium would show a Brewsterian angle of plane polarisation in the region below 2700 A. has been verified. The angle found for 2500 A. was 37°, which makes the refractive index $n = 0{\cdot}75$. I am not yet sure how accurately the angle can be determined, or how complete the polarisation is, but the intensity ratio of the two images obtained with a quartz Rochon prism was 1 : 120. The images had equal intensity in the visible and near ultra-violet.

Total reflection is thus to be expected for angles of incidence greater than 50°. This too was verified, at least in part, though I have not yet secured a sharply defined angle. At normal incidence the reflection at wave-length 2200 A. is of the order of 2 per cent, and the first few photographs taken indicate that a rather high value sets in for angles greater than 45°—though the increment seems to be gradual as the angle increases above this value. Better results are expected when more nearly plane reflecting surfaces are secured.

The angle of polarisation shows thus far no evidences of dispersion, which is perhaps to be expected, as the dispersion of the metal in the visible region is extremely small, as shown by Duncan, from measurement of principal incidence angles and azimuths.

Interference maxima and minima up to the fifth order appear in the spectrum of the reflected light between $\lambda = 2100$ and 3000 (not 2700 as reported in my earlier letter).—R.W.W.

Absorption Spectrum of Vitamin A at Low Temperatures

WE have been trying to devise more precise physical criteria for the recognition of biologically important molecules. Obviously, the only ultimate test for such a molecule is its action on living organisms. Physical tests can, however, be used as a guide to decide whether it is worth while to apply biological tests.

The physical criterion which has proved most valuable in this field is the absorption spectrum of the complex molecules, but this has nearly always been measured in solution at ordinary temperatures, and has usually given broad structureless bands which frequently appear similar for different molecules.

At low temperatures the bands of many molecules develop a structure with a considerable amount of detail[1], since (i) the ground-states of the molecules are simplified by the elimination of all but those of lowest energy, and (ii) the blurring caused by the molecular fields of neighbouring molecules is reduced as these become quiescent. Both effects tend to *diminish the width of the absorption bands* and to bring out details of structure which cannot be recognised at atmospheric temperatures. These structured bands can be used as a much more definite discriminant than the continuous bands obtained at ordinary temperatures.

Thus, in the case of carotene dissolved in ethyl alcohol, the visible bands at

4790, 4440, and 4200 A.

become sharper and are displaced to

4990, 4670, and 4350 A.

whilst a fourth band appears at 4060 A. On the other hand, the ultra-violet band at 2700 A. becomes narrower, but it is not displaced and develops no structure.

This method of analysis has been used to discriminate between vitamin A and the product, giving a band near 3280 A., obtained by irradiating carotene[2] with the mercury line Hg 2650, under conditions which probably permitted the access of traces of oxygen. The two physical tests for vitamin A (the absorption band with its maximum at 3280 A. and the development of a blue coloration with antimony trichloride) did not discriminate between these two materials; but we now find that when concentrates of vitamin A are cooled to the temperature of liquid air, the maximum at 3280 A.* is displaced to 3350 A. and that new bands are developed at

2900, 2770, 2580, 2510, and 2430 A.

The last three were of low intensity. Identically the same structure was found in a B.D.H. concentrate and a concentrate from turbot liver oil, prepared by Dr. T. Moore. The detailed structure may conceivably be due to an impurity associated with vitamin A, but this difficulty cannot be completely excluded from any spectroscopic observations not made upon pure substances.

When the product obtained by irradiating carotene is cooled, the band near 3280 A. breaks up into a series of bands at

3780, 3570, 3410, and 3210 A.

The more precise spectroscopic test therefore shows definitely that the molecule produced by irradiating carotene is different from that associated with the band at 3280 A. in vitamin A concentrates.

We propose to extend this method of investigation, by cooling with liquid hydrogen in order to develop more fully the fine structure of the absorption bands of complex molecules.

F. P. BOWDEN.
S. D. D. MORRIS.
C. P. SNOW.

Physical Chemistry Laboratory,
Cambridge.
March 22.

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* A faint subsidiary maximum at 3100 A. was also observed at ordinary temperatures for all the concentrates examined.

[2] L. R. Arnold, Jr., and G. B. Kistiakowsky, *J. Amer. Chem. Soc.*, 54, 5, 1713; 1932.

[1] F. P. Bowden and C. P. Snow, NATURE, 129, 720; 1932.

Cultivation of Parasitic Nematodes

THE following is an outline of a method of obtaining large numbers of the larvæ of nematodes parasitic in sheep in media the composition of which can be much more accurately controlled than any that have hitherto been used. Experimental work on these organisms should throw light on the physiology of nematodes and be of great assistance in the treatment and control of these parasites.

(1) Obtain eggs from the fæces, or contents of the large intestine of sheep, by placing these in a cone shaped sieve and passing water through this into a large jar, stirring all the time. Allow the contents of this jar to settle, pour off the fluid, and repeat two or three times. Mix a portion of the final sediment with an equal quantity of a solution of sugar 1 lb., water ¾ pint, formaldehyde 1 per cent. Fill a narrow-mouthed vessel rather overfull with this and cover the top with a large cover-slip, taking care that there are no air bubbles left. After 12 hours or so, remove the cover-slip, and wash off the eggs floated up on it to a clean tube[1].

Another method is to obtain female worms from the fourth stomach and intestines of sheep, and to set free the eggs by breaking up the worms in a mortar with a little water. By this method the easily-obtained species *Graphidium strigosum*, common in the stomach of English wild rabbits, or *Trichostrongylus retortæformis* in the duodenum, give excellent cultures. Eggs obtained in this way do not hatch so well, probably because fewer are mature.

(2) Wash the eggs in a centrifuge three or four times in sterile water to remove sugar solution and debris.

(3) Treat for 30 minutes with 5 per cent Antiformin in 10 per cent formaldehyde[2]. Experiments are being done here on various other and less drastic antiseptics.

(4) Wash six times in sterile distilled water.

(5) Sow the eggs into sterile Petri dishes in which is a layer not more than 3 mm. deep of plain broth 1 part water 10 parts. Simpler media are now being devised.

(6) Inoculate each dish with a loopful of *B. coli*. It is possible that the larvæ will not develop on some strains of this organism. The strain used in this laboratory has been obtained from the intestines of the parasitic stages of the larvæ themselves.

(7) Leave the dishes at 18°–20° C. preferably in the dark or in the shade. Third stage infective larvæ, enclosed in their characteristic loose sheaths (which are the cast skins of the second stages which have not been thrown off) will be present in 6–10 days. The hatching of the first stage larvæ can be quickened by incubating the cultures, but this may also cause too rapid a growth of the *B. coli* and is not necessary.

Thousands of free-living stages of the larvæ can be so obtained and should be excellent subjects for experimental work. The number of larvæ obtained is limited only by the number of eggs used.

(8) The first parasitic stages can be obtained by placing the third stage larvæ in a 1 in 20 dilution of 'Milton'. They ex-sheath in 20 minutes or less at laboratory temperature. Stronger solutions damage or kill the larvæ. Other solutions containing hypochlorite will also induce ex-sheathing, but I have found the above to be best, because it remains stable, and ex-sheathed larvæ will live three or four days in the dilution of 1 in 20. Hypochlorite appears to be essential, chlorine failing to cause ex-sheathing.

(9) This 'Milton' solution also sterilises the larvæ

and kills the *B. coli*, so that these first parasitic stages can be put into sterile media, of whatever composition the worker desires.

(10) More than two hundred media have so far been tried in attempts to cultivate these ex-sheathed larvæ further, but so far no method has been found of inducing them to cast the next sheath and so become fourth stage larvæ. Experimental work is needed to find out the conditions required for this.

It is impossible in a brief letter to indicate the innumerable problems which have arisen during the working out of this method, but I should be glad to supply further details to anyone interested. There are also many interesting problems for the study of which the 'adult' nematodes parasitic in sheep might be used, rather than such relatively specialised species as *Ascaris*.

GEOFFREY LAPAGE.

Institute of Animal Pathology,
Cambridge, March 11.

[1] Wood, Second Rep. Direct. Inst. of Animal Path. Cambridge, 1931, p. 204.

[2] McCoy's method, *Amer. J. Hyg.*, 11; 1930. An important paper, giving the results of its author's experimental work by modern methods on eggs and larvæ of *Ancylostoma caninum*.

Anode Spot in a Neon Tube

WHILE studying the phenomena of the moving striation and anode spot in a discharge tube filled with neon, our attention was directed to the fact that the anode spot is intermittent in its emission, with a rhythmic fluctuation in its intensity.

A photograph taken by a falling plate camera is reproduced in Fig. 1, while Fig. 2 shows another plate taken in a similar way but with the portion near the anode more magnified. In Fig. 1, + and − denote anode and cathode respectively, which were about 17·5 cm. apart. The discharge tube was a straight one 4 cm. in diameter. It was filled with pure neon at a pressure of a few centimetres and was excited by a 2 kw. direct current generator giving 1,200 volts, the current in the tube being 190 ma. T.M. are the time marks, with an interval of 1/800 sec.

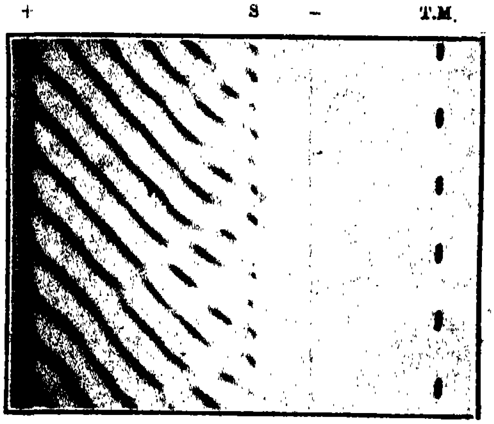

FIG. 1.

As will be seen in Fig. 2, the image of the anode spot, which was single in this case, is discontinuous in its emission. In fact, we see a series of luminous dots gradually increasing in its intensity, until, near the maximum intensity, one layer of the moving striation is detached from the anode and proceeds toward the cathode. The process is repeated at an interval of about 1/1160 sec. In the case shown in Fig. 1 the velocity of the moving striation, at the middle of the positive column, is about 30 metres per second.

Another point of interest seen in Fig. 1 is the rhythmic fluctuation in the intensity of each of the moving striations. Apparently, the intensity of each stria decreases as it approaches the cathode, until it begins to appear on the plate as discontinuous strips. Near the end of the positive column, a small luminous sphere is seen which is detached from the uniform positive column. The luminosity of this sphere (marked S in Fig. 1) is also found to be intermittent, with an interval of 1/1880 sec.

The remarkable regularity in the arrangement of the strips in Fig. 1 would seem to suggest that there may be an interference between the moving striæ and some kind of disturbance regularly coming against it from the cathode.

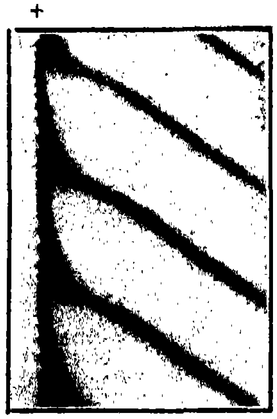

FIG. 2.

As the anode spot is in fact the starting point of the moving striation, the closer investigation of its change with time may be of significance in the study of discharge through gases.

The details of the experiment will be published in the Scientific Papers of this Institute.

T. TAKAMINE.
T. SUGA.
A. YANAGIHARA.

Institute of Physical and Chemical Research,
Komagome, Hongo-ku, Tokyo.
Jan. 23.

Rôle of the Solvent in Electrolytic Dissociation

IN a recent paper[1] Sir Harold Hartley and Mr. O. L. Hughes bring forward evidence for the view that "solvation (of ions) is a *statistical* process, the relative amounts of the two kinds of molecules (in non-aqueous solutions containing small quantities of water) being roughly proportional to the concentrations in which they are present in the solution". This view is supported by the work of Butler[2], who found that, although lithium chloride in alcohol-water mixtures is solvated preferentially by water, solvation by water is not an exclusive process.

Sir Harold Hartley goes on to interpret the degree of association of electrolytes in terms of (1) the size of the solvated ions, considered as rigid structures the motion of which obeys Stokes's law, and (2) the distance of approach of oppositely charged ions below which, according to Bjerrum's formula[3], the number of ion-pairs (consisting of solvated ions) increases rapidly.

In the light of the aforementioned ideas about solvation, is this treatment free from objection? On the statistical view of solvation, the solvent shell around an ion cannot be a rigid structure. An individual solvent molecule can leave it and its place be taken by another molecule or perhaps by an oppositely charged ion. Consequently the solvent shell of an ion does not act as an impenetrable barrier to other ions and undissociated molecules of the kind which occur in vapourised strong electrolytes at temperatures such as 2,000° C. can be formed. The size of the solvated ion is not of prime importance. The deciding factors are the free energies of the systems (1) cation and anion solvated to average extent and (2) undissociated molecule, possibly solvated as well. That solvation of an undissociated molecule may be a factor comparable with solvation of an ion can be shown by an approximate calculation for a dipole similar to that of Born for an ion[4].

The larger ionic radius in non-aqueous media often given by Stokes's law[1,5] may be due to the solvent molecules being larger and hence the solvated ion larger, although the energy of solvation may be less than in water and the solvent shell may even contain a smaller number of molecules.

Chemistry Department, A. R. MARTIN.
University of Aberdeen.
March 25.

[1] Hartley and Hughes, *Phil. Mag.*, **15**, 610; 1933.
[2] Butler and Shaw, *Proc. Roy. Soc.*, A, **129**, 519; 1930.
[3] Bjerrum, see Falkenhagen, "Elektrolyte", p. 257, Leipzig, 1932.
[4] Martin, *Phil. Mag.*, **8**, 547; 1929.
[5] Davies, "Conductivity of Solutions", p. 183, London, 1930.

Dimensions of Fundamental Units

PROF. CRAMP has proposed[1] that the dimensional expressions for the electrostatic and electromagnetic units may be simplified by regarding quantity of electricity Q as fundamental. To my reply[2], that including Q would cause confusion because, whereas M, L and T are quantities which vary with the velocity of the observer, Q is invariant, Prof. Cramp's[3] rejoinder is the question: How it is known that Q is invariant? The invariance of the charge carried by a moving particle is, I believe, generally accepted. A simple proof of the consistency of this invariance with the special principle of relativity is given in N. R. Campbell's "Modern Electrical Theory", p. 361.

Prof. Stansfield[3] makes a plea for the simplification introduced by regarding k and μ as mere numerals. I agree with Prof. Stansfield, but in order to make this point of view logical, I think that we must regard 'magnetic pole', m, as a unit derived from 'electric charge', Q, rather than as an independent unit.

The hypothesis tentatively accepted in physics is this, that there are in the physical world two fundamental factors, namely, positive charges ('protons') and negative charges ('electrons'). Each of these is a symmetrical radial field of unlimited extent. The lines of flux of the proton are directed radially outwards, those of the electron radially inwards. The lines possess 'tension' and also 'mass per centimetre', the magnitudes of which agree (in analogy with $v = \sqrt{F/m}$ for the transmission of transverse disturbances along a stretched string) with the fact that transverse disturbances are transmitted along the lines with the velocity, c, of light. Fluxes similarly oriented show mutual lateral repulsion; those oppositely oriented show attraction. Vectorial combination of fluxes permits the resultant forces to be expressed in terms of the tensions in the lines. When electric fluxes are in relative motion, laterally, the 'charges' from which they emanate exert mutual forces on account of this relative motion, namely, the charges are mutually repelled when their laterally approaching fluxes are oppositely oriented, and are mutually attracted when the fluxes are similarly oriented. Experiment shows that the magnitude of these forces depends on the relative lateral velocity of the fluxes.

In empty space the law of force between charges Q and Q^1, at rest, d cm. apart, is $f = Q \times Q^1/d^2$. Usually, however, the space is not empty but contains some medium, that is to say, it contains protons and electrons. These exert forces on Q and Q^1 and the resultant apparent mutual force between Q and Q^1 is not $(Q \times Q^1)/d^2$ but is $(Q \times Q^1)/kd^2$, where k is a *numeral* intended to take account of the 'nature of the medium'.

The force between charges, resulting from relative lateral motion of their fluxes, involves Q, Q^1 and d and, in addition, the velocity of relative lateral motion. This force is called 'magnetic'. Its value, for two moving fluxes due to charges in empty space, involves only Q, Q^1, d and the relative velocity v of lateral motion of the fluxes, but in space which is not empty but contains a medium, the apparent mutual force between Q and Q^1 is due, partly, to the action on the fluxes of Q and Q^1 of the fluxes due to moving protons and electrons in the medium.

A 'unit magnetic pole' is a fictitious thing. There are no known means of producing such a field of flux as a unit pole is imagined to produce. The notion of such a pole is useful, however, because we can produce by means of currents (that is to say, by moving charges) effects (locally) such as poles ought to produce. This means, I think, that we assume the meaning of the equation $f = (m \times m^1)/\mu d^2$ to be the same as that of the equation $f = (Qv \times Q^1v)/\mu d^2$ where μ is a numerical constant taking into account the presence of moving charges within the medium, and v is the relative velocity with which two like charges must move past each other in order that their 'magnetic' repulsion shall equal their 'electrostatic' repulsion. Experiment has shown that this velocity is c, the velocity of light.

If then we write Coulomb's laws, $f = (Q \times Q^1)/kd^2$ for charges and $f = (Qc \times Q^1c)/\mu d^2$ for magnetic poles, we find that the nature of a charge, Q, may be expressed either as $k^{\frac{1}{2}}df^{\frac{1}{2}}$, using the E.S. system of units, or as $\mu^{\frac{1}{2}}df^{\frac{1}{2}}c^{-1}$, using the E.M. system, the ratio of the two expressions being c, the velocity of light.

From this simple point of view, which I think is sound, we must regard both k and μ as mere numerals, and 'pole', m, not as an independent unit but as equivalent to the product $Q \times c$. Always we measure a thing by its effects. Charge has two ways of producing the same effect. A charge Q at distance d from a like charge repels that charge *electrostatically* with force f if the charges are at rest, or *magnetically* with the same force f if the charges have relative lateral motion of c cm. per second.

F. M. DENTON.
Department of Electrical Engineering,
University of New Mexico,
Albuquerque.
Feb. 12.

[1] NATURE, **130**, 368, Sept. 3, 1932.
[2] NATURE, **130**, 892, Dec. 10, 1932.
[3] NATURE, **131**, 59, Jan. 14, 1933.

Boundary Tides in the Kattegat

In order to facilitate observations on the vertical movements of the boundary surface far from the shore a recording boundary gauge has been constructed. A commercial steel barrel of about 200 litres capacity used for kerosene was provided with an axial tube of two inches width running through the barrel and having its ends welded to the flat ends of the barrel. Thick glass rings inserted at both ends of the tube serve to reduce friction against a vertical guide, 25 metres in length, of phosphor-bronze wire rope, which runs straight through the tube. The wire rope has its upper end attached to a large buoy, which is kept five metres below the surface by means of a double anchorage[1], a heavy weight attached to the wire rope at its lower extremity keeping it vertical and well stretched. The barrel is thus free to move in a vertical direction between depths of 6 and 30 metres.

The barrel, filled partly with large spherical glass floats, partly with fresh water, was hermetically closed and finally balanced with the recording instrument and with an additional load, so as to be in equilibrium in sea-water of the density 1·022. This is the average density of the water at the boundary surface in the central Kattegat, where two or three such instruments were kept anchored during several weeks of the fall of 1932. By means of a precision pressure gauge attached to the barrel, its varying depth, which may be taken as equal to the depth of the boundary, is recorded on a large drum turned by clockwork, which runs for three weeks or more. An automatic record of the boundary waves is thus obtained, which it would otherwise require continuous hydrographic soundings from ships anchored at the points of observation to realise. Moreover, the boundary gauges also draw their records under weather conditions which would make observations from anchored ships impracticable.

The records prove that very considerable wave-like movements of the boundary round its average depth at about 17 metres were going on the whole time the instruments were working. The total depth at the anchored systems varied between 40 and 60 metres. Waves of a semidiurnal period between 11 and 13 hours from crest to crest, with a maximum height of about 6 metres, were conspicuous in the diagrams. These waves attained their largest amplitude about full moon and new moon, but there were also considerable variations in amplitude apparent over shorter intervals of time.

A harmonic analysis carried out on a fortnight's record gave an amplitude of the semidiurnal lunar tide in the boundary of ± 0·6 metres (the M_2–component tide), and of the semidiurnal solar tide ± 0·2 metres (the S_2–component tide). The surface tides in the Kattegat are much smaller; thus at Varberg the amplitude of M_2 in the surface is ± 0·038 metres and of S_2 ± 0·01 metres. The amplitudes of the tidal components in the boundary brought out by analysis, however, only account for a fraction of the maximum height of the boundary waves in our records.

Boundary waves of semi-diurnal period were first discovered in the Great Belt in 1907 by Otto Pettersson and have since then been recognised at other localities and also in the open sea by other observers. Local variations in the amplitude of the waves revealed by our records seem to support Zeilon's theory, that topographical features of the sea-bottom play an important part at the generation of the boundary waves.

It is of interest to note, that 'inertia currents' similar to those found from current measurements in the central Baltic (see the accompanying letter by Gustafson and Kullenberg), appear also to influence the boundary movements in the Kattegat. An analysis of one of our curves carried out with periods varied by steps from 13·9 to 14·5 hours gave a very distinct maximum of amplitude ± 0·3 metres for the sine curve with a period of 14·3 hours, which is equal to 12 pendulum hours at the latitude of the anchored systems : φ = 57° 15′ N. Analysing shorter fractions of 6 × 14·3 hours, the amplitude of the same sine curve occasionally rises to ± 0·7 metres, and the phase as well as the amplitude undergoes irregular variations, such as may be expected from waves set up by extraneous forces.

It is suggested that boundary gauges of the type here described suspended from ships, either drifting or at anchor, may be used for the study of such short period boundary waves, as were observed in the central Atlantic Ocean during the *Meteor* expedition.

Hans Pettersson.
Börje Kullenberg.

Bornö Station.
Feb. 8.

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[1] Nature, 115, 639, May 2, 1925.

Inertia Currents in the Baltic

Theoretically, a particle moving without friction on the surface of a rotating planet should describe a circular path in the course of twelve 'pendulum hours', that is, with a period given by $T = \frac{\pi}{\omega \sin \varphi}$ where ω is the angular velocity of the rotation and φ is the latitude. It is generally assumed, that these movements are insignificant compared to the currents actually existing in the ocean.

In the course of Swedish investigations on the downward spread of the wind-current, carried out by means of recording current-meters suspended from large buoys, which were kept well below the surface by means of double anchorage, currents, apparently of the inertia type, were recorded near the surface in the central Baltic, lat. 56° 44′, long. 19° 37′, depth of observation 17 metres, total depth 136 metres. Beside a current of nearly steady direction set up by the wind, there was a current component turning clock-wise at the rate of 24° 6′ an hour. This rate remained practically constant for several days, so that altogether fifteen revolutions were made in about eight days. A strong wind blowing for some thirty hours in the middle of the observations produced a change of phase in the rotation, but the angular velocity before and after the break remained the same.

When the residual current was strong, the rotating current caused periodic variations in its velocity and direction, but when it was weaker than the rotating current, as was generally the case, the resultant current described spirals, which soon approached to an almost circular movement.

The period of the rotating current is on an average 14½ hours, whereas 12 pendulum hours at this latitude amount to a value slightly less or 14·3 hours. Measurements at different depths, from 11 to 22 metres, and at different points in the same locality, gave practically the same results.

A natural interpretation of these results would be, that in the Baltic, where tidal movements are very small, the wind current, as the wind abates, gradually degenerates into a circular, or rather a spiral, movement of decreasing amplitude, the diameter of the paths of the water-particles varying from some 3 kilometres downwards. It appears likely, that similar 'inertia currents' are also to be found in the sea, at least where the tidal movements are not too strong to obscure them completely. An examination of current-records from the west coast of Sweden is being undertaken with this purpose.

Torsten Gustafson.
Börje Kullenberg.

Bornö Station.
Feb. 8.

Factors Controlling Date of Spawning in Frogs

In Nature of April 8, p. 521, reference is made to the factors which determine the time of spawning of the common frog, *Rana temporaria*.

Through the courtesy of the Royal Meteorological Society, I have been enabled to utilise the voluminous data contained in the Society's Phenological Reports for the investigation of this matter. The results, it is hoped, will shortly be ready for publication, but since the matter has now been raised, it may be of interest to state briefly that frogs are scarcely at all affected by the weather at the time of spawning, or that immediately preceding, but there is a close relation between the mean temperature over a long period prior to spawning and the mean date of spawning in a district. For example, within fifty miles of London, only a few cases of spawning usually occur in February, and March is the usual spawning month, most reports being about the middle of the month. I have calculated a correlation co-efficient of $-0\cdot77$ between the mean temperature at Kew for *February* and the mean spawn date for the area. The effect of March temperature is perceptible if one employs a weighted mean, allowing for the distribution of the spawn dates over the period, but it is much smaller. The only important effect of the weather at the time of spawning seems to be the break in the normal sequence of spawning caused by a very cold 'snap'.

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Early History of the British Solomon Islands

Several references were made in the Calendar of Geographical Exploration published in Nature last year to the Solomon Islands, and the following notes on their early history may be of interest.

The Solomon Islands lie some five hundred miles east of New Guinea and were discovered on a voyage from Callao, Peru, in 1568 by the Spaniard, de Mendaña. After naming most of the larger islands during a six months' cruise, the two frigates returned to South America.

Mendaña named the islands after King Solomon with the idea of attracting colonists to search for gold and treasure. However, it was not until thirty years later that a second expedition of four ships set sail but failed to find the Solomons proper, arriving instead at Santa Cruz Island to the east, where a brief settlement was made until Mendaña's death in October 1595. The survivors (only three ships arrived) under the Portuguese navigating officer de Quiros made an attempt to reach San Cristobal, previously discovered in 1568. Not only were they unsuccessful in locating it, but they also failed to strike any land before the Philippines, whence they sailed for Peru.

For nearly two centuries nothing was known of the Solomons until Capt. Carteret in the *Swallow* rediscovered Santa Cruz and Malaita in 1767, without however landing anywhere. Next year came the French navigator de Bougainville, followed by de Surville (1769), Maurelle (1781) and Shortland (1788).

The climax of eighteenth century navigation was the shipwreck of two frigates under La Perouse which reached Vanikoro, Santa Cruz, in 1788, but about which nothing was known for forty years until Dillon, in command of the East India Company's *Research*, found proof in 1827 of their fate.

By this time whalers and traders, the latter in search of bêche-de-mer, sandal wood and tortoise-shell, had already begun the nineteenth century commercial exploitation of the tropics.

R. J. A. W. Lever.

Tulagi,
British Solomon Islands Protectorate,
Jan. 20.

A New Alloy, 'Stainless-Invar'

Invar, *invented* by Ch. Ed. Guillaume *in* 1896, has a small coefficient of thermal expansion, about $1\cdot2\times10^{-6}$. Since then, no better invar has been obtained. I have, for the last six years, been engaging in the investigation of alloys having a small coefficient of expansion and obtained in June, 1929, an alloy[1] containing about 63·5 per cent iron, 31·5 per cent nickel and 5 per cent cobalt, which has a smaller coefficient of expansion than that of fused silica.

Several explanations of the small expansibility of invar have been proposed, but none can be considered to be satisfactory. I also tried to explain this phenomenon and developed a new theory[1] by which the small expansibility of invar can be satisfactorily explained from magnetic data. Following up this theory, I began to investigate the thermal expansion of the ternary alloys of iron-cobalt-chromium and found that an addition of a small quantity of chromium to iron-cobalt alloys containing more than 50 per cent cobalt considerably reduces their expansibility. In July, 1931, I obtained an alloy having a much smaller coefficient of expansion than that of fused silica. For example, the coefficient of linear expansion at ordinary temperature of an alloy containing about 36·5 per cent iron, 54·5 per cent cobalt and 9 per cent chromium is less than 10^{-7} in the annealed state, and that of another alloy having a very similar composition *to the above has* even a negative coefficient amounting to $-1\cdot2\times10^{-6}$. These alloys are so resistant to corrosion that polished surfaces can be left for several months in a moist atmosphere, water, sea water, etc., without showing any rust spots; they have been called 'stainless-invar' (Hakar Masumoto).

Kôtarô Honda.

Research Institute for Iron,
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Sendai, Japan.
March 10.

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[1] *Sci. Rep. Tôhoku Imp. Univ.*, **20**, 101; 1931.

Research Items

Ethnology of Manihiki and Rakahanga, Cook Islands. Te Rangi Hiroa (Dr. P. H. Buck) has published as a separate monograph (Bull. 99, Bernice P. Bishop Museum), that part of the material collected by him on the Cook Islands expedition which was derived from the two atolls Manihiki and Rakahanga. The special interest of this investigation lies first in the fact that the people of the two atolls were one, passing as a body from one atoll to the other when forced to migrate by the depletion of the stock of coco-nuts and taro, until 1852 when the practice was stopped, owing to the loss of life in transit, and the community split into two; and secondly, because the original settlers were a single biological family—a fact which has had a marked effect on social organisation and tradition. According to tradition, the atolls were discovered by Huku of Rarotonga, who later settled his sister and her husband Toa on them. No priests came with the settlers; and in consequence the traditions and mythology are defective, the genealogical records poor in extent and detail—the primary parents are not remembered—and for seven generations the people had no gods. Family genealogies give a period of about 550 years from the first settlement, this agreeing with the date of the last migration to New Zealand. Owing to the peculiar circumstances of the settlement, Toa, in order to secure a male heir, married each of his four daughters and his granddaughter in succession, sons being born of the last two unions only. Male descent is all-important in the succession to rank and title, otherwise descent is bi-lateral; but more importance is attached to male descent, unless the mother comes of the more important lineage. After the people had been without gods for seven generations, two gods were introduced from another island.

Bitumen in Embalming. From the time of Herodotus onwards, the tradition has been that the Egyptians made use of bitumen, mainly from Judæa, in embalming; but since 1908, Mr. A. Lucas, of the Government Laboratories, Cairo, has contended in a series of papers that bitumen did not come into use for this purpose before the time of the Ptolemies, and that even though it might have been used for this purpose then and afterwards, he had found no evidence of it. For his evidence he relied on solubility tests and on sulphur content, in which Judæan bitumen is high, as well as characteristic smell, fluorescence and the colour and appearance of substances extracted by solvents. Dr. Percy E. Spielmann has now applied the tests of fluorescence and spectroscopic analysis of the ash to certain samples (*J. Egypt. Arch.*, 18, pts. 3–4). While bitumen gives no trace of fluorescence, samples of resin show colours averaging round a strong yellow ochre. In the spectroscopic analysis, vanadium and nickel, accompanied by molybdenum, were the predominant components in the bitumen ash; but on the other hand the resins show only the faintest trace of these metals, so that they could be used for detecting the presence of bitumen. When applied to Egyptian material—from a cranial cavity (Ptolemaic), a head (Ptolemaic), and bones from the junction of ribs and spine—it was found that there was strong evidence, with certain reservations, for the presence of bitumen in two of the three samples examined. A similar examination made with wood-tar, a material the presence of which Lucas had definitely identified, suggested that the metal-free wood-tar would be just the substance to act as a diluent for both the bitumen and the resin, thus accounting for their presence in embalming material in relatively low proportions. It seems clear, however, that bitumen was used in embalming, mixed with wood-tar and resin.

Vital Capacity and Occupational Characteristics. "Physiological Standards and Occupational Characteristics of Bodily Functions of the Japanese" by Tomoyosi Isikawa (Reports of the Institute for Science of Labour, Kurasiki, Japan) gives the results of measurements of vital capacity in nearly 8,000 Japanese ranging from four to eighty-two years of age. The aim of the investigation was to obtain some standard of physical fitness as an aid to vocational guidance. A modified Hutchinson's spirometer was used for measuring the children and students, and Verdin's centilitre spirometer was used for the adults. Vital capacity in the Japanese appears to increase rapidly up to sixteen years of age and then rises slowly to a maximum between 25–29 years in males and 30–34 years in females. Compared with some European and American data, the Japanese, especially the women, have a low vital capacity. The average measurement for 875 males aged 15–81 years was 3,213 c.c. while for 562 females aged 15–71 years the mean was only 1,964 c.c. Some attempt was made to assess vital capacity in various types of occupation but in most instances the numbers in the groups were too small to give any reliable figures. There is some indication that those engaged in light or sedentary work tend to have a low vital capacity. Dr. Isikawa would be well advised to refer to English reports on vital capacity by Greenwood, Newbold and Cripps in which the difficulties of establishing a standard of physical fitness are carefully discussed. These authors concluded that the inherent variability of vital capacity, even within homogeneous groups of apparently healthy persons, is so great that the fixation of a normal standard is impossible.

Californian Sponges. Mr. M. de Laubenfels has recently described the sponge fauna of the western coast of the United States (*Proc. United States Nat. Mus.*, 81, No. 2927, Art. 4. Smithsonian Institution, 1932). Six out of a hundred and one species discussed are new and three new genera and five new varieties are established. Very little literature on Californian sponges has been published, therefore this work is specially welcome, containing as it does, in addition to the systematic parts, extensive notes taken in the field whenever possible on the living sponges. To mention but a few of these interesting observations there is the description of *Spheciospongia confederata* de Laubenfels, the largest sponge in the world (the author having frequently found examples nearly a metre across and mentioning a definite record of one of nearly three metres), and remarkable for its changes of colour when transferred from its original habitat. *Mycale bellabellensis* (Lambe) is also very large, funnel-shaped with a height of at least 100 cm. and a diameter of 122 cm. Many of the species are beautifully coloured, rich brown, red, yellow and blue when alive. In one case at least the deep blue colour is due to symbiotic organisms in the ectosomal regions. A species of *Gellius* grows abundantly on the floor of a cavern just below low tide, a most unusual habitat.

Phylogeny in the Genus *Oenothera*. Since the investigation by de Vries of feral *Oenothera Lamarckiana* in Holland the genus of the evening primroses has been studied from many points of view in Europe and in the United States. Prof. R. Ruggles Gates (*J. Linn. Soc. Bot.*, **44**, 173; 1933) considers the evolution of the section *Onagra*. A table of the known North American species is given and another summarises investigations of the genetic complexes and chromosome catenations in those species which have been cytologically examined. It is suggested that the subgenus *Onagra* was derived from the large-flowered subgenus *Raimannia* in Central America and that a series of dominant mutations occurred as the genus spread northwards with the retreat of the ice at the end of the last ice age. Interspecific crossing played an important part in the development of the subgenus, as a result of which most of the species are permanent crypthybrids composed of two complexes and breeding true because of catenation (linkage of their chromosomes) during meiosis. Hybrid vigour may well have led to survival and spread of such species. There is evidence that dominant mutations giving rise to smaller flowers have appeared independently and successively in different parts of the Continent from different lines of descent. Species and varieties with cruciate petals constitute another series of independent parallel mutations. It is urged that while interchange of segments between non-homologous species (internal hybridisation of Lotsy) will account for the appearance of a certain number of new types, its value as an evolutionary factor is limited in comparison with the importance of interspecific crossing and the regular occurrence of gene mutations in the hybrid swarm. Two new species are described and figured.

Age of the Andes in Ecuador. A paper on "New Fossil Fresh Water Molluscs from Ecuador" (*Proc. U.S. Nat. Mus.*, No. 2946; 1932) by W. B. Marshall and E. O. Bowles deals with a collection made by Dr. George Sheppard in the Cuenca district of Ecuador, and it includes three new genera, each represented by a new species. The genera have been named *Sheppardiconcha*, *Potamolithoides* and *Ecuadorea*. In regard to the age of these fossils, all of which are of fresh-water habitat, the authors conclude that it "cannot be later than Pliocene, and it may be earlier". According to Dr. Julia Gardner, the discovery of these fossils in the Azogues Sandstone of Ecuador is "apparently a confirmation of the theory indicated from an earlier collection from Peru that the ancestors of the recent fauna of the lower La Plata are to be found near the headwaters of the Amazon, where they lived before the divide between the Amazon and the La Plata was established". The discovery of late Kainozoic fossils in the sediments of this interandine region of Ecuador proves the existence of a continental facies of the Kainozoic rocks in this part of the world, which is almost certainly homotaxial with the marine beds of the coast-belt, and assists in the elucidation of the many tectonic problems which are associated with the uplift of the Andes in the same region. As the Azogues Sandstone, the principal formation occupying the Cuenca Basin, and in which the fossils above referred to were found, are folded into fairly steep and symmetrical anticlinal folds with a north and south trend, it is apparent that this structural movement must have post-dated the age of the included fossils of the stratified deposits, and hence may be post-Pliocene.

Humidity Tables. Messrs. Negretti and Zambra have recently placed on the market for the price of 3*s*. 6*d*. a set of tables of relative humidity for use with artificially ventilated wet and dry bulb hygrometers. The range of temperature is from 100° F. to 212° F. Dry bulb readings are set off on the left hand side of the table in steps of 2° F., and the depression of the wet bulb to the right, also in steps of 2° F. The tables are printed on both sides of a celluloid tablet which measures about 5 in. × 3½ in. There is a leatherette case to protect the tablet from damage when not in use. The figures have been derived from centigrade tables published by the National Physical Laboratory and these have been extrapolated to give a greater range. This completes a series of four similar sets of hygrometer tables, two on the Centigrade scale, with upper limits of 50° and 100° C., and two on the Fahrenheit scale, one ranging from 20° F. to 120° F. and the other, as described above, from 100° F. to 212° F. They agree closely with the Assmann and the U.S. Bureau of Standards Humidity Tables. The arrangement of the figures is convenient, and the printing is not only very clear on the sample specimen but is also deep enough to ensure continued clearness even with constant use. At the highest temperatures on the Fahrenheit scale a depression of the wet bulb of 78° is provided for, the corresponding relative humidity at 194° F. being so low as 11 per cent.

X-Ray Investigation of the Copper-Aluminium Alloys. A. J. Bradley and Phyllis Jones have re-examined (March meeting of the Institute of Metals) this system using the powder method. They confirm that the body-centred β-phase cannot be retained by quenching, and show that, contrary to the opinion of Obinata, a homogeneous β′-structure is invariably produced, which appears to be closely related to that of the face-centred α-phase. Alloys quenched in the γ-range are indistinguishable from the δ-alloys. Up to 19 per cent aluminium, the structure of δ-CuAl is essentially of the γ-brass type, photometer measurements leading to the formula Cu_9Al_4. The modification of the δ-phase beyond 19 per cent noted by Westgren is confirmed. In this δ′-phase (19–22·5 per cent aluminium), the number of atoms in the pseudo-cubic cell falls from 52 to 49. On quenching a two-phase alloy with 22·8 per cent from 700° C., the single ε-phase is obtained, which appears to be cubic. Between this composition and 29 per cent of aluminium, the annealed alloys show many types of structure, the η-phase consisting, therefore, of a number of phases of small range of stability, or one or more of gradual modification. Friauf's structure for the θ-phase, $CuAl_2$, is confirmed and it is also confirmed that this phase has not a unique composition.

Wilson Photographs of Cosmic Ray Phenomena. A full account of the results obtained by Blackett and Occhialini with their cloud-chamber photographs of cosmic ray phenomena has appeared (*Proc. Roy. Soc.*, March). The experiment has been described in a letter to NATURE (130, 363, Sept. 3, 1932). The Wilson chamber is placed with its axis horizontal in a magnetic field of about 3,000 gauss, and the mechanism of the chamber is operated whenever there are simultaneous discharges of two Geiger-Müller counters placed above and below the chamber. Some of the photographs show single tracks passing through the chamber, but in many cases there are 'showers' of tracks numbering up to twenty or so. Similar showers have just been reported by Anderson (*Phys. Rev.*, March 1). Many of the particles appear to diverge from a single point inside or outside the chamber—in some cases ten or more such radiant points can be detected. Many of the tracks are not appreciably bent by the magnetic field; some tracks are apparently due to electrons, and others seem to require for their explanation a particle of approximately electronic mass with positive electrical charge. The direction in which the tracks are bent by the field indicates a positive charge if we accept very strong evidence of the direction of motion. The ionisation along the tracks is then found to be far too small for a particle having proton mass and charge and the experimentally found magnetic deflection ($H\rho$). The ionisation is comparable with that in an electron track of similar $H\rho$. The existence of a positive electron in cosmic ray track photographs, which has also been suggested by Anderson, is therefore very probable. The suggestion of the authors is that the positive and negative electrons are created by a collision process, and that they may perhaps be identified with the "quantum states of negative kinetic energy unoccupied by electrons" postulated by Dirac. These particles should have only a short life; they can be annihilated by a negative electron jumping into the unoccupied state, the energy being converted into radiation. The calculated lifetime of these positive electrons is not inconsistent with observing them in the cloud chamber. Protons and heavy particles generally seem to be infrequent and perhaps absent in the cosmic ray photographs.

Hydrogen Isotope. G. N. Lewis has described some preliminary experiments in which water containing a large proportion of the hydrogen isotope H^2 has been obtained (*J. Amer. Chem. Soc.*, March). When ordinary water is electrolysed, the heavy isotope accumulates in the residue, and water of specific gravity 1·035 was obtained, containing one-third of its weight of the heavy isotope. The refractive index of this water is considerably lower than that of ordinary water, and it is considered probable that the chemical properties of compounds containing H^2 will be very different from those of ordinary hydrogen compounds. Other communications from the United States show that measurements in the Bureau of Standards indicate that heavy water freezes when surrounded by melting ice, its freezing point being 0·05° C. above zero. Its boiling point is higher than 100° C.

Astronomical Topics

Nova of March 20. A preliminary announcement of the discovery of this nova appeared in NATURE of April 15, p. 553. Dr. Kukarkin, of Moscow, states in U.A.I. Circ. 434 that he has found three images of this star on old Moscow plates; on 1899 March 14 its magnitude was 14·1; on 1900 March 21 it was 13·8; on 1907 February 13 it was 13·0. Plates taken on the following dates failed to show the star (the figures in brackets after the dates show the limiting magnitudes of the plates): 1901 April 9 (14·5); 1903 April 16 (13·5); 1905 March 1 (14·1); 1905 March 27 (13·5); 1905 April 8 (14·8); 1907 April 5 (13·9); 1908 January 3 (16·0); 1908 March 29 (14·8); 1910 March 1 (14·5); 1911 February 21 (14·8). Dr. Kukarkin suggests that it is a variable star of the U Geminorum type; it may have a period of about a year, but there must be some irregularity in it. The decline must be very rapid; Dr. Delporte notes in U.A.I. Circ. 434 that plates taken on March 25 and 29 go down to mag. 17·5, but there is no trace of the nova.

The Gegenschein or Counterglow. The German astronomer, Theodor Brorsen, discovered this faint patch of light opposite to the sun in the year 1855. It is difficult to observe, and can only be seen in perfectly clear air free from all glare of terrestrial lights, and when it does not fall on the Milky Way. A bulletin issued by Science Service, Washington (Feb. 11), describes a study of it made recently by Dr. C. T. Elvey at the Yerkes Observatory; he used the 40-in. refractor and a photoelectric cell to measure the luminosity. Several series of measures of light were made along parallel lines running north and south, each long enough to cover the Gegenschein and the dark sky outside it. The measures, when reduced, were plotted; they exhibited the Gegenschein as an oval area, its length along the ecliptic being 22°–35°, and its breadth in latitude 21°–26°. These dimensions are about twice as great as the area that was visible to the unaided eye. The integrated luminosity was determined to be −0·28 magnitude, which is brighter than any of the stars except Sirius and Canopus; but being spread over a large area the intensity is very feeble at any point. The report states that "at the centre, where brightest, the intensity is equal to that of a star of magnitude 6·2"; this is, however, indefinite in the absence of indication of the size of the patch of light included. October and November were found to be favourable months for the study; the region being north of the equator, and away from the Milky Way.

The phenomenon is believed to be an extension of the zodiacal light, looking brighter than elsewhere owing to proximity to the earth, and the full illumination of the particles. It is conjectured that there may be an actual concentration of particles near the earth, describing periodic orbits under the combined attraction of sun and earth.

Ephemerides of Variable Stars. The Cracow Observatory undertook at the request of the International Astronomical Union the task of preparing yearly ephemerides of eclipsing variable stars. No. 11 has appeared, bearing the title "Rocznik Astronomiczny". It is edited by Prof. T. Banachiewicz, and contains ephemerides of 800 stars, and elements without ephemerides of 722 more. The book also contains tables of precession and obliquity, and predictions of occultations of stars by the moon for Cracow and four other Polish Observatories. The explanations are given both in Polish and in Peano's flexible Latin.

A supplement to the *Japanese Astronomical Herald*, vol. 25, contains observations of variables made in Japan in 1932, and predicted maxima of 90 long-period variables for 1933.

Structure of Cellulose

THE recent annual Convention of the Technical Section of the Paper Makers' Association of Great Britain was unusual in that the subject chosen was one which appeared at first sight to be more of academic than of practical interest. Fortunately, in the able hands of Prof. H. Mark, of the University of Vienna, who opened the conference, the subject lost many of its complexities, and technical men present were stimulated to attempt to apply theory to their practical problems.

Prof. Mark's paper, which is published in a special issue of the *World's Paper Trade Review*, dealt principally with the structure of cellulose. He supported the theory, now generally accepted, that cellulose is built up of so-called micelles consisting of bundles of parallel chains of glucose molecules, and he dwelt at some length on the controversy which at present concerns the actual length of these chains. The majority of the evidence, including that based on the chemical properties of cellulose, points to a length of 150–200 glucose units, and yet one cannot ignore the work of Staudinger on viscosity, which can only be explained by a much higher figure. It may be that the lower figure represents a minimum value.

In opening the general discussion, Sir William Bragg referred to the X-ray evidence on which so much of this work is based. Subsequent speakers paid some attention to the much-debated question of the mechanism of the hydration which occurs when paper is beaten, and a suggestion was made that the resulting change in structure is analogous to that which occurs in the manufacture of true cellulose plastics by chemical reaction.

Prof. Mark also indicated how such theories might be applied to problems in the art-silk industry, although it seems that they can do little at present to explain what occurs when cellulose is beaten for paper-making, as this problem is concerned with water absorption rather than with modification of crystalline structure. When, for example, a silk fibre is bent, the outer layers are stressed more than the inner core, and so long as the elastic limit of the latter is not surpassed the fibre will return to its original position and will thus show resistance to creasing. Unfortunately, this resistance is usually decreased when a fibre is treated so as to increase its tensile strength, but it is now possible to obtain the core more highly orientated than the surface and so to preserve both properties. Here one can take a leaf from the book of Nature, since this difference in orientation is already present in the natural silk fibre. If, however, the silkworm is placed on a revolving rod, and is therefore compelled to spin more rapidly, it descends to the level of human endeavour so far as lack of creasing-resistance of its product is concerned.

Prof. Mark obviously voiced the opinion of those present when he stated that the interaction of water and cellulose is one of the most interesting questions in paper-making. He chose to approach the problem by taking absorption capacity as an index of changes produced in the area and quality of the surface of the fibre by chemical treatment or by beating. His results indicate that hydroxyl groups are responsible for the fixation of water molecules on the surface of the cellulose, and act by virtue of the secondary valencies of the oxygen atoms; treatment with a chemical reagent opens up small slits or holes in the micelle into which further molecules of water may pass. Penetrations of solvents and swelling agents into the cellulose lattice is not unknown, but as a rule X-rays show evidence of well-defined addition compounds. Until now, however, no one has succeeded in preparing a true cellulose hydrate, so that an important link in an otherwise strong chain of evidence is still missing.

Sunspots and Meteorological Phenomena

IN a monograph entitled "L'Influence Solaire et les Progrès de la Météorologie"[*] Henri Mémery advances the theory that sunspots show a tendency to increase and decrease at certain definite times of the year, and that this tendency is shown whatever period of years is considered. He suggests further that there is a relationship between the amount of sunspot development and numerous terrestrial disturbances, for example, spells of abnormal rainfall and temperature, and also between individual groups of sunspots and meteorological phenomena. Fifty years of solar and meteorological observations made at the Observatoire de Physique solaire et de Météorologie, Talence, provide a large part of the experimental data on which his views are based.

To most astronomers and meteorologists, the theory that sunspot activity shows any permanent relationship with the dates on our terrestrial calendar will probably appear a highly improbable one, to be accepted only in the face of overwhelming evidence of its truth. The evidence in this paper rests upon curves showing the average area on the sun's disc covered by sunspots on each day of the year for periods of 12, 41 and 50 years. There are, however, apparent discrepancies between the lengths of the periods implied by the statements made alongside these curves and those given above the curves. The periods are quoted as 12, 40 and 50 years in the latter case and it is possible that 40 should replace 41 in the algebraic expressions given below. It will be seen, however, that the conclusions reached are not affected by this uncertainty, nor even by the doubt as to whether the 12 year period should not have been taken as 13 years. Few would deny that the three curves show considerable similarity, but the periods covered are 1889–1901, 1880–1920, and 1880–1929, that is, the 12 years in the first group are used also in the groups for 41 and 50 years, and the overlap is even greater for the 41 and 50 year means.

The question arises whether the similarity in the curves cannot be explained simply by this overlap. Take the case of the curves for 12 and 41 year periods. The similarity between these is held to imply a positive correlation between the ordinates. The two variables are x_1, and $(12x_1+29x_2)/41$ where x_1 and x_2 are the means for the common period of 12 years and for the *remaining* 29 years of the 41 year period, respectively. The correlation between x_1 and $12x_1/41$ is of course unity, and, unless it is true that the shapes of the annual sunspot curves obtained by using entirely separate series of years are similar, the correlation between x_1 and $(12x_1+29x_2)/41$ will by a well-known statistical formula bear the same *ratio to unity* as does the standard deviation of $12x_1/41$ to the standard deviation of $(12x_1+29x_2)/41$. This correlation coefficient works out to $+0·38$.

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[*] L'Influence solaire et les progrès de la météorologie : résultats de 50 années d'observations solaires et météorologiques comprenant les observations et les recherches effectuées à Talence à partir de 1900. Par Henri Mémery. Pp. iv+23. (Talence : Observatoire de Physique solaire et de Météorologie, 1932.)

The correlation coefficient between the 12 and 41 year mean curves was then determined, using the ordinates of the two curves at the beginning and middle of each month. The figure found was $+0·38$, that is, exactly that which is to be expected solely from the overlap. (The *exact* agreement between the two coefficients must of course be accidental. Had the experimental figure been even $+0·5$ or $+0·6$ the evidence that the overlap was not the cause of the similarity would still have been inadequate, but with a coefficient of $+0·8$ or more the author's claim would have been well supported.) A similar analysis could be applied to the other pairs of curves, but it has been deemed sufficient to show by a single random test that a faulty method has been used with misleading results. Although no further example of overlapping is evident in the comparative curves illustrating the other relationships claimed in this paper, the method adopted throughout has been to give purely statistical evidence for alleged physical relationships in such a way that a critical reader cannot see, until after considerable mathematical analysis of this evidence, whether the latter does in fact give any support for the supposed relationships.

It seems safe to conclude that most astronomers and meteorologists will not accept the author's ideas until more up-to-date statistical methods are used.

E. V. N.

Atmospherics Research in the Southern Hemisphere

A FEW years ago the Australian Council for Scientific and Industrial Research established a Radio Research Board to conduct scientific and technical research into some of the more fundamental problems associated with radio communication. Amongst the items of work which it was planned to carry out were the repetition of some of the investigations already in progress in Great Britain under the British Radio Research Board, with the view of obtaining a direct comparison of the propagation of electric waves in the two hemispheres. As a useful aid in this matter some of the investigators appointed in Australia had the advantage of receiving their training in radio research under the organisation in Great Britain. The results of the work already carried out in Australia are being published in a series of special reports, and the latest of these is entitled "Atmospherics in Australia (I)".* This report contains the results of observations made chiefly by means of two cathode ray oscillograph direction-finders supplied by the British Radio Research Station at Slough, where this type of instrument has been developed to a high degree.

The first series of observations were made on board the s.s. *Baradine*, in December 1929 and January 1930, when Messrs. Munro and Huxley were on their way to Australia to take up their appointments. After setting up the apparatus on board, observations were made on the transmissions from a number of European stations to enable a calibration curve to be obtained showing the error in apparent direction of arrival of the waves caused by the metal work of the ship. Regular daily observations on atmospherics were commenced one day before reaching Port Said and were continued during the remainder of the voyage. From the indications on the cathode ray oscillograph screen, both the true direction of arrival and the strength of each atmospheric was recorded. These observations, which were carried out on a wave-length of 30 km., supplied very definite evidence in favour of a thunderstorm origin for atmospherics. The directions, as recorded on the voyage through the Red Sea and across the Indian Ocean, converged on an area in Central Africa which is known to be the most active thunderstorm area in the world. Beyond Colombo, the directions of most of the other sources of atmospherics observed passed through other active thunderstorm areas in the East Indies and Northern Australia. Round the south coast of Australia, the predominant sources appeared to be within, or near to, the north of the continent.

On arrival in Australia, the apparatus used on the ship was installed near Melbourne for preliminary observations. Towards the end of 1930, a second cathode ray direction-finder arrived in Australia and was set up on a selected site about three hundred miles from the first instrument. The circuit arrangement of each instrument was modified to make the oscillograph unidirectional in its indications, and a short-wave wireless link was provided between the two stations so that simultaneous recording of the direction and intensity of individual atmospherics could be carried out; and such observations were commenced in March 1931. The majority of these observations were carried out on a wave-length of 3 km. as it was thus found possible to restrict the range from which atmospherics were received to about 2,000 miles, whereas on a wave-length of 30 km. the range was at least 5,000 miles. The origins of the atmospherics observed were located by taking simultaneous bearings at the two stations. Systematic observations taken in this manner on a wave-length of 3 km. showed that the range of intensities, when corrected for the distance travelled and the attenuation in the path, was quite small, being of the order of 4 to 1; and also that the intensity distribution about the mean was a normal probability one.

A large proportion of the atmospheric sources located were within the Australian continent itself. The small range of intensities noted above suggests a similar origin for all the atmospherics observed, and this has been confirmed by the correlation found between the indicated sources of the atmospherics and those of the thunderstorms located through the normal meteorological observation network. The authors conclude from their investigations that all the atmospherics observed had their origins in lightning strokes occurring generally in thunderstorms, or possibly, in a few instances, in dust storms. Observations of atmospherics have therefore been found to have definite meteorological value as they enable barometric depressions to be located and traced by observing the atmospherics which are generally associated with them.

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* G. H. Munro and L. G. H. Huxley: "Atmospherics in Australia. (I)". Radio Research Board, Report No. 5. Melbourne. 1932.

Information on the diurnal and seasonal variation in the activity of atmospherics covering a period of more than a year is also given in the report. It has been found that the maximum activity of atmospherics occurs in the afternoon from 3 to 4 p.m. in any locality, although this maximum is less marked for sources over sea than for those over land. In Australia, atmospherics are very prevalent over the tropical areas in summer, but in winter, atmospherics arising within the continent are relatively few, those observed being associated with barometric depressions. Towards the end of 1931 two automatic directional recorders, of the narrow-sector type developed in Great Britain, were installed, and with the aid of these instruments more complete information on diurnal and seasonal variations is being obtained.

The report shows that this line of research has been satisfactorily established in Australia on a sound basis, and the results of the continuation of the investigation will be awaited with interest.

Hæmolytic Streptococci[*]

THE group of micro-organisms known as the hæmolytic streptococci is responsible for a number of acute inflammations in various regions of the body, such as erysipelas, heart disease, and puerperal fever, as well as for such diseases as scarlet fever and certain types of pneumonia. In addition, they are important secondary invaders, attacking those whose resistance is already lowered by some other infection. They spread in the body both by the lymph and the bloodstream and are frequently found on mucous surfaces in apparently healthy individuals. They are only known as parasitic upon the animal body and appear to maintain themselves in a human population like the meningococcus or pneumococcus, namely, by carriers.

Since these organisms are responsible for so many different diseases, it is of interest to inquire whether a particular variety of hæmolytic streptococcus is associated with each different disease. The late Sir Frederick Andrewes devoted seven years to the study of this problem and a report of the investigation, prepared for publication by his colleague, Mrs. Christie, and Dr. Christopher Andrewes, has now been issued.

The hæmolytic powers of *Streptococcus pyogenes*, the typical hæmolytic streptococcus, depend upon the production of a definite toxin which passes out into the medium and disintegrates the limiting membrane of the red blood cells: this soluble hæmolysin will pass through porcelain filters of the coarser type. The living organisms also reduce hæmoglobin or may convert it to methæmoglobin. As a method of separating the different types, it was soon clear that agglutination tests by themselves would prove of little value. It was necessary for an accurate antigenic analysis to carry out quantitative agglutin-absorption tests. Antisera were prepared by injecting an emulsion of the streptococci, killed by exposure to dilute formaldehyde in the cold for some days, intravenously into rabbits, on alternate days for about four weeks. The sera obtained had high titres. In carrying out a test, graduated doses of an emulsion of the organism are added to the same volume of serum. After standing overnight, the tubes are centrifuged and the clear supernatant fluid pipetted off and titrated, that is, its agglutinating power for the strain with which the serum was prepared, is tested. The closer in type the strain used for the absorption of agglutinin is to the latter, the less agglutinin will there be left unabsorbed, and vice versa.

The investigation has shown that these hæmolytic streptococci have such inherent powers of adaptation to their chemical environment as to make it impossible, for the present at any rate, to prepare a permanent systematic classification. The methods used for discrimination between forms of different origin may themselves change the characters of the organisms under observation. Only exceptionally are two strains serologically identical, but very rarely are they entirely dissimilar. In the case of scarlet fever, it appears that no one serological form can be credited as causal agent, though three or four recognisable serological types seem to be quite commonly found in it. An occasional representative of a scarlet fever group was found among the puerperal, surgical and erysipelas strains, but otherwise no distinct types stood out from this mixed group.

The general conclusion is that this group of organisms is in a state of constant flux in which it is difficult to find any firm foundation for a permanent systematic classification: success is probably unattainable by purely serological methods of investigation. The dangers of the hæmolytic streptococcus to human life appear to arise from this instability of behaviour: it has a special facility in adapting the refinements of its living chemistry to the particular host environment in which it finds itself. Progress would seem to lie in a deeper knowledge of the exact chemical events involved in this reaction between the host and the invading organism.

University and Educational Intelligence

CAMBRIDGE.—At King's College the following have been elected to fellowships: A. G. D. Watson, scholar and Harold Fry student of the College, and E. S. Shire, Reginald John Smith student and formerly scholar of the College.

THE use of sound films as an aid in the teaching of physical science is being tested in the University of Chicago with a series of twenty films of which the first two, entitled "Oxidation and Reduction" and "The Molecular Theory of Matter", have been produced under the supervision of the professors of chemistry and physics of the University. Three others on "Energy and its Transformation", "Electrostatics" and "The Velocity of Light" are in preparation. Similar series of twenty films each are to be produced dealing with biological science, social science and the humanities. The technical work is in charge of Erpi Picture Consultants and further particulars can be obtained (according to an article in the January issue of *School Life*) from the University of Chicago Press, 5750 Ellis Avenue, Chicago, Ill.

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[*] "The Hæmolytic Streptococci: their Grouping by Agglutination". By Frederick W. Andrewes and Ethel M. Christie. Medical Research Council, Special Report Series, No. 169. Pp. 73. (London: H.M. Stationery Office, 1932.) 1s. 3d. net.

Calendar of Nature Topics

Varieties of Agricultural Crops

There is no simpler method of improving output than by sowing a good variety of seed instead of an inferior one. It is the first step in raising the standard of farming in new or undeveloped areas, and has given striking results when soil improvement by fertilisers would have been impracticable. Moreover, a new variety may enable the limitations imposed by climate to be overcome. A rapidly maturing strain of wheat extends the wheat area by making the most of a short growing period, a drought-resisting variety brings in areas of low rainfall. Choice of seed is usually the most practicable method of mitigating the effects of plant disease caused by fungus or insect pests; this is particularly the case with crops of low value per acre which will not bear the cost of spraying. Immunity of particular varieties to disease is very rare, but when it occurs, as for example to the wart disease of potatoes, it is exploited to the full. More usually it is a case of a more or less marked degree of resistance, and then the aim of cross-breeding is to unite the disease resistance of one strain with the valuable agricultural qualities of another. The problem is never a simple one, for very many attributes are involved. It is further complicated by the fact that resistance to one disease may be associated with susceptibility to another.

Much is being done in Great Britain to improve existing varieties and introduce new ones. With crops already highly developed, spectacular improvements are unusual; the gain in yield or quality is generally small and special field technique is required in order to establish the extent of the improvement, and the agricultural areas in which the new strain may be substituted for the older kinds. Stiff-strawed varieties of cereals, high quality wheat and barley, beetroots rich in sugar, mangolds of high dry matter content, have all been developed in this way. A special case of raising varieties to suit a particular environment may now be in sight. There is no shortage of potential soil fertility in the form of cheap synthetic nitrogen compounds. An outcome of this might be the development of varieties specially suited to unusually rich soil conditions and able to effect an economical conversion of mineral fertilisers into farm produce.

Potatoes in the Fens

Potato planting is now in progress in the great black plain south of the Wash, probably the most sharply defined agricultural area in England. Even the town dweller, as the train carries him through Ely, March, or Peterborough, can scarcely fail to realise that here is something quite distinct from the 'country' as is usually understood. At this season, we see on all sides the black soil laid up in ridges, the bright red farm-carts serving gangs of women with seed potatoes for planting, and the horse-drawn ridgers covering in three rows of sets at once. Those who regard farm work as a leisurely and ill-organised occupation, should spend a few hours on a fenland farm in mid-April. The work proceeds with astonishing smoothness and rapidity and a very high standard of workmanship is attained.

The black land is capable of growing good crops of potatoes on its own resources, but is considerably helped by superphosphate. Indeed, the fenland farmer must be the most systematic user of superphosphate in Great Britain, for many of them recognise no other manure.

Having got his potatoes in, the farmer's chief anxiety is the extent to which his crop will be reduced by 'blight' which, although controlled by spraying, may seriously damage the crop in certain seasons, and the price of potatoes in the following winter. These two considerations are not unrelated, however, for a reduced crop generally means higher prices, although not necessarily sufficient to compensate for the lower yield.

In spite of considerable fluctuations in returns, the potato crop has no serious rival in this district. Sugar beet affords a useful alternative, and is widely grown, and carrots, celery, and mustard occupy some potato land. Cereals are extensively grown to balance the acreage, and the straw, which is particularly luxuriant in this fertile district, finds a special use in covering potato clamps during the winter.

Sperm Whales in the North Atlantic

Sperm whales are now relatively scarce animals, and the experience of the modern whaling stations which worked from the northern and western islands of Scotland, was that few sperms were captured in these waters and that they were invariably solitary bulls, truants from the schools. But in the great days of whaling, there were recognised about a dozen 'whaling grounds' for sperms in the North Atlantic, visited by the whalers during fairly definite seasons. Sperm whaling was not a seasonal trade, as was the fishing of the right whale from British sea-ports, for the sperm whalers were fitted out for a voyage of from two to four years duration and caught whales wherever they could be got. Therefore the appearance of whalers year after year at a fairly regular succession of places suggests definite movements or migrations on the part of the whales. When Charles H. Townsend plotted on a world-map the positions and dates of captured sperm whales recorded in the hundreds of log-books fortunately preserved in New Bedford Public Library, U.S.A., he found that April marked the opening of sperm-whaling in the North Atlantic. With few exceptions, the records above lat. 25° N. point to the presence there of sperm whales from April to September; in the Sargasso Sea they occurred in the summer of the northern hemisphere; between lat. 25° N. and the equator they were taken mainly during the October to March season; and along the coast of South America and towards the Cape of Good Hope the catches were largely made during the same season—summer in the southern hemisphere.

Young Barnacles Change their Coats

In the seas of western Scotland, the latter half of March is marked by the appearance in the plankton of myriads of the nauplius larvæ of barnacles (*Balanus*)—about a month later than the corresponding event in southern England. For a time the larvæ may be so numerous as to form the predominant constituent of the plankton, suggesting that the countless barnacles which whiten shore rocks spawn profusely and almost simultaneously, to the immediate benefit of the many shore animals which feed upon such organisms. In April, and particularly in the latter half of the month, the nauplii moult for the last time and assume the new cyprid form, which soon attaches itself by head and antennæ and glues itself by secretion from the cement gland to rocks, stones, shells, piles of piers or whatever object may be on the spot. Then in this, which Darwin called the "pupa stage", some of the juvenile structures are lost and the free-swimming larva is transformed into the immobile adult. This is why fishermen haul their boats from the sea during the month of May and scour and scrub their hulls, for the newly settled brood of barnacles is still easily removable, whereas in a week or two more they would form a firm encrustation. In the days of sailing ships the attachment and growth of vast numbers of barnacles, sessile and stalked, during a long voyage, materially obstructed the way of the ship.

Societies and Academies

LONDON

Geological Society, March 8. D. A. BRYN DAVIES: The Ordovician rocks of the Trefriw district, North Wales. The area described extends from Trefriw and Dolgarrog in the Conway valley south-westwards to Capel Curig. The Glanrafon beds are correlated with the beds immediately underlying the Snowdon volcanic suite in Snowdonia, and with the beds of the same name underlying the volcanic suite at Dolwyddelan. The Crafnant volcanic series is considered to represent an incomplete development of the Snowdonian suite, the bedded pyroclastic and probably also the upper rhyolitic series being absent. In the neighbourhood of Dolgarrog, the Crafnant series is faulted against a thick development of pumice-tuff and spilitic agglomerate overlain by rhyolite-tuff and rhyolite. These are regarded as contemporaneous with the Crafnant series, but representing, in part at least, the products of a different centre of activity. The fauna of the Llanrhychwyn Slates, comparing closely with that of the Lower Cadnant Shales of Conway, places the underlying volcanic series in the Llandeilian, and indicates its correlation with the upper part of the Conway Volcanic series. V. WILSON: The Corallian rocks of Yorkshire. (1) The Howardian Hills. Three divisions of the Corallian are recognised and their stratigraphical relations are dealt with in detail. The important rôle played by the spicular remains of the lithistid sponge *Rhaxella perforata* Hinde in the building up of the Lower Calcareous Grit is recognised for the first time. Calcareous, and many varieties of siliceous, spicules are described, and their distribution is discussed. Though perfect lithological continuity exists between the Lower Calcareous Grit and the overlying Osmington Oolite series, the absence of any representatives of the Hambleton Oolite series and the Middle Calcareous Grit containing fossils characteristic of these two divisions is considered to indicate the existence of a non-sequence in this area. In the later stages of the Osmington Oolite period reefs became established, and numerous facies deposits accumulated from the erosion of the reefs. As the Lower Calcareous Grit passes gradually into the Oxford Clay below, so the Upper Calcareous Grit gradually gives place to the overlying Kimeridge Clay in the North Grimston district, there being no unconformity such as was formerly supposed.

PARIS

Academy of Sciences, March 6 (*C.R.*, 196, 653–732). The President announced the death of Magnus de Sparre, *Correspondant* for the Section of Mechanics. E. MATHIAS: Contribution to the study of fulminating matter. The phases of its explosion by cooling. RENÉ LAGRANGE: Poncelet's theorem and a class of cyclids. GLAGOLEFF: Effective and general construction of the Cremona transformation in the plane and in space. JACQUES WINTER: An application of Schrödinger's theory of perturbations to a problem where the degenerescence persists up to the *n*th approximation (Mathieu's equation). HENRI CARTAN: Groups of pseudo-conformal transformations. N. ARONSZAJN: The decompositions of uniform functions. MLLE. ESTRADÈRE: The oxidation of some hydrocarbons. A study of the oxidation of hexane, cyclohexane and cyclohexene under conditions favourable to the production of explosions. M. KÉFÉLI: The suppression of rolling and pitching. J. DELSARTE: Spherical evolution. PIERRE VERNOTTI: The best method of assuring a thermal isolation. TH. V. IONESCU and MME. IRÈNE MIHUL: The absorption of energy in ionised gases. L. DUNOYER and P. PAOUNOFF: A state of working of photoelectric cells containing gas. G. RIBAUD: The measurement of the total factor of transmission of the coloured filters used in heterochrome photometry. A. HAUTOT: The structure of the *K* line of boron. This line has been described as having a width of 3 A. (Söderman) or 5 A. (Prins). With a spectrograph of high dispersion it has been found to be double, the two lines being 1·25 A. apart. PIERRE BRICOUT: A magnetic apparatus for the determination of thicknesses. The continuous and automatic measurement of the thickness of thin sheets or the diameter of fine wires is a problem of interest both in the laboratory and the works. The method described is applicable if the magnetic permeability of the specimen is practically equal to that of air: variations of 0·1 micron can be detected. K. BORATYNSKI and A. NOWAKOWSKI: The modifications of phosphoric anhydride. The crystalline modification has a specific gravity of 2·284 at 20° C., 2·207 being that of the amorphous modification. AUGUSTIN BOUTARIC and JEAN RATELADE: Rhythmic precipitation in stretched gels. A. PORTEVIN and P. BASTIEN: Contribution to the study of the physical and mechanical properties of the magnesium-aluminium-copper alloys, rich in magnesium. R. CAZAUD: The influence of the degree of cold hardening produced by wire drawing on the limit of fatigue of mild steel. GEORGES FOURNIER and MARCEL GUILLOT: The relation between the absorption of the β-rays by organic compounds and the molecular structure of the latter: halogen derivatives. PAUL BAUD: The soda factory of Nicolas Leblanc. A. TRAVERS and LU: The separation of phosphoric, arsenic and vanadic acids from aluminium. The vanadium is removed by heating to 400° C. in a current of gaseous hydrochloric acid. FÉLIX TROMBE: The preparation of metallic neodymium free from iron and silicon. The metal is prepared by electrolysis of the chloride, after removal of oxychloride by prolonged heating in dry hydrochloric acid. The metal is heated in a high vacuum at 1200° C. to remove potassium: it contains about 0·02 per cent of iron, less than 0·05 per cent of silicon and only spectrographic traces of calcium. R. TRUCHET: The oxidation of the true acetylenic hydrocarbons by selenious oxide. The preparation of α-acetylene alcohols. The oxidation of the hydrocarbon $CH_3.(CH_2)_4C{\equiv}CH$ with selenium dioxide gave the secondary alcohol $CH_3.(CH_2)_3.CH(OH).C{\equiv}CH$. The next homologue, octyne, behaved in a similar manner on oxidation. L. Royer: The orientation of certain crystals by hydrargillite. A peculiarity in the orientation of crystals deposited in contact with macled calcite. L. J. Spencer: The origin of tectites. Michel and Lacroix have suggested that tectites are formed in the atmosphere from meteoric materials composed of silicon and the light metals, fused by the heat developed by friction with the air. The author suggests an alternative hypothesis according to which meteorites of meteoric iron impinging on desert sand have developed sufficient heat to melt the sand into a silica glass. This accords with the high percentage of silica found in tectites (see also Nature, 131, 117, Jan. 28, 1933). F. Blondel: The average amount extracted from copper minerals. A. Marin and P. Fallot: The connexion of the dislocations of Punta Piscadores with those of the limestone chain of the Rif. C. E. Brazier and L. Génaux: Some remarks concerning the earthquake of March 2, 1933. Discussion of the results obtained on the seismograms at the Observatory at Parc Saint-Maur. Ch. Maurain: Remarks on the preceding communication. The amplitudes of the movements of the ground recorded during the earthquake of March 2 last are probably the greatest ever observed in the Paris region for movements of seismic origin. Henry Hubert: The climates of the French tropical domain. Zb. Sujkowski: The presence of Radiolaria of the Phæodaria group in the lower Carboniferous of Poland. René Vandendries and Harold J. Brodie: The sexual radiations in the Fungi. Mlle. M. L. Verrier: The eyes and vision of *Cerastes vipera* and *Vipera aspis*. Mme. Andrée Drilhon: Phosphorus and moulting in crustaceans. Mme. Hufnagel and Marcel Joly: The action of the X-rays on the metamorphosis of insects. Robert Sorel: Tincture of iodine and asepsis. The author questions the utility of tincture of iodine used as a preliminary wash for the skin in surgical operations, especially if lengthy. It appears to act as a varnish, and results as good can be obtained with a varnish not containing an antiseptic.

Forthcoming Events

Monday, April 24

University of Cambridge, at 12—(Rouse Ball Foundation Lecture).—Prof. B. L. Van der Waerden: "The Aims of Modern Algebra".

Royal Geographical Society, at 5.30—(Film).—R. J. Flaherty: "South Pacific Pictures".

National Institute of Industrial Psychology, at 6—(at the London School of Economics, Houghton Street, W.C.2).—Mrs. W. Raphael: "The Selection and Training of Office Staff".

Royal Society of Arts, at 8—(Cantor Lectures).—W. Augustus Steward: "Goldsmiths' and Silversmiths' Work—Past and Present" (succeeding lectures on May 1 and 8).

Tuesday, April 25

Eugenics Society, at 5.30—(at the Rooms of the Royal Society, Burlington House, Piccadilly, W.1).—Symposium on "Eugenics and Religion". Speakers: Capt. G. H. L. F. Pitt-Rivers and the Rev. A. H. Gray.

Gresham Lectures in Astronomy, at 6—(at Gresham College, Basinghall Street, E.C.2).—A. R. Hinks: "The Star Map of the Future" (succeeding lectures on April 26, 27 and 28).

Institution of Civil Engineers, at 6.—H. G. E. Cherry: "The Influence of Earthquakes on Structural Design". F. W. Furkert: "The Effect of Earthquakes on Engineering Structures". J. J. Booth: "The Design of an Earthquake-Resisting Structure: The Dominion Museum, Wellington, New Zealand".

Wednesday, April 26

London School of Economics, at 5.—Prof. A. W. Marget: "The Natural Rate of Interest" (succeeding lectures on April 27 and May 3 and 4).

Royal Society of Arts, at 8.—Dr. W. H. Gibson: "Future Developments in the Flax and Linen Industries".

Thursday, April 27

London Mathematical Society, at 5—(at Burlington House, Piccadilly, W.1).—Prof. B. L. van der Waerden: "Hypercomplex Numbers".

Institution of Electrical Engineers, at 6—(Twenty-fourth Kelvin Lecture).—Sir Frank E. Smith: "The Travel of Wireless Waves".

Friday, April 28

Association of Economic Biologists, at 11.45—(in the Botany Lecture Theatre, Imperial College of Science and Technology).—Dr. S. Dickinson: "The Nature of Saltation in *Fusarium fructigenum*". At 2.30, Special General Meeting. At 2.45, Dr. C. B. Williams: "Observations on the Desert Locust in East Africa"; A. M. Massee: "The Strawberry Tarsonemid Mite".

Society of Chemical Industry (Chemical Engineering Group), at 6.45—(at the Waldorf Hotel, Aldwych, London, W.C.2).—Annual General Meeting. The Right Hon. Lord Melchett: "Modern Economics and Unemployment".

Royal Institution, at 9.—Dr. James Gray: "The Muscular Movements of Fishes".

Faraday Society, April 24–25—(at the Royal Institution, Albemarle Street, London, W.1).—General Discussion: "Liquid Crystals and Anisotropic Melts".

Official Publications Received

GREAT BRITAIN AND IRELAND

Wool Industries Research Association. Report of the Council, 1932–33. Pp. 39. (Leeds.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1495 (T. 3187): Improvement of Airscrew-Body Performance by Radial Vanes. By F. C. Johansen. Pp. 27+8 plates. 1*s*. 6*d*. net. No. 1496 (T. 3315): Acceleration of an Aeroplane upon entering a Vertical Gust. By L. W. Bryant and I. M. W. Jones. Pp. 16+15 plates. 1*s*. net. (London: H.M. Stationery Office.)

OTHER COUNTRIES

University of California Publications in American Archæology and Ethnology. Vol. 33, No. 2: The Eastern Kuksu Cult. By E. M. Loeb. Pp. v+139–231. (Berkeley, Calif.: University of California Press.) 1 dollar.

The University of Colorado Studies. Vol. 20, Nos. 2 and 3. Pp. 115–268. (Boulder, Colo.) 1 dollar.

L. S. Ornstein: a Survey of his Work from 1908 to 1933. Dedicated to him by his Fellow-Workers and Pupils. Pp. iv+121. (Utrecht.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions, Vol. 82: Interne Gezeiten-Wellen. By O. Pettersson. Pp. 26+viii. (Copenhague: Andr. Fred Høst et fils.) 1.75 kr.

Isotyphs: showing the Prevalence of Typhoons in Different Regions of the Far East for each Month of the Year 1932. By T. F. Claxton. Pp. 2+12 plates. (Hong Kong: Royal Observatory.)

Council for Scientific and Industrial Research. Pamphlet No. 37: The Sheep Blowfly Problem in Australia. Report No. 1. (N.S.W. Department of Agriculture: Science Bulletin No. 40.) Pp. 136+6 plates. (Melbourne: H. J. Green.)

Colony of Mauritius. Annual Report of the Royal Alfred Observatory for the Year 1931. Pp. 4. Miscellaneous Publications of the Royal Alfred Observatory. No. 13: The Cyclone Season 1930–31 at Mauritius. By M. Herschenroder. Pp. 6+22 plates. (Mauritius.)

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Biotechnology

IN an address to the University of New Zealand, referred to briefly in NATURE of April 15, p. 538, the Chancellor, Dr. J. Macmillan Brown, emphasised the need for building university education on broader foundations than the narrow specialisation which seems to prevail. Every degree, however specialised or technical, should have as its first stage the broadest culture possible. In this Dr. Macmillan Brown was only echoing a point of view stressed at greater length by Dr. Flexner in his well-known work "Universities: English, American and German", as well as by Prof. Findlay and others in recent addresses. The absence of anything like a true *universitas literarum* has long been lamented by close observers of our university life who have seen the dangers of the rapid development and inevitable specialisation, which result in young men of all countries being so immersed in their own special branches of science that they have scarcely the time or energy to devote to the study of more comprehensive problems.

The peril is indeed increasing, and the tendency to over-specialisation, to exclusive preoccupation with one small field of science, is definitely greater than a couple of decades ago. Even industry is suffering from the absence of perspective in the recruits which it now draws from the universities, and this the more in that, as the general cultural level falls, the demand for a sense of values and of perspective increases, industrial advance like scientific development originating more and more in the borderline sciences which are common ground to two or more of the great divisions of knowledge. Science is, after all, only one of the many civilised activities of mankind and inevitably suffers from any prolonged isolation from those other activities. The specialists' knowledge must therefore be supplemented by comprehensive surveys of the problems before science.

The value of such contributions, not merely to the understanding of the present position of science but also to the interpretation of the many difficult social, economic, and political problems with which our civilisation is confronted, is scarcely to be computed by those who have received no training in science. The need to-day is for those who can truly interpret the values of human life, and recent literature testifies not merely to the capacity of the man of science to assess such values, but also to the indisputable fact that when he is freed by a broad culture and outlook from the restraints of a narrow specialisation, he forms such judgments of value like all other men, and that indeed to become an investigator demands a certain sense for judgments of value. Moreover, even in specialisation at its worst, the man of science has learnt to discard the dogmatism with which he so justly reproached the theologian of a former generation, but with which he was frequently strongly tainted himself.

The change which has come over science in this respect can scarcely be attributed to the tendency of scientific laws, even in modern chemistry and physics, to assume the character of average or statistical laws, or even to the convergence of scientific investigation. It may be due in part to the realisation that the classification of the sciences is largely arbitrary and inadequate—that differences existing between physics and history or biology, for example, are mainly in the complexity of the material and not in the method. Human actions in history are so overwhelmingly complicated that general laws are much more difficult to discover, and consequently to apply, than are physico-chemical laws. It may be due, further, to the recognition that it is fundamentally wrong to believe that we now hold in our hands the absolute and final truth in any category value. As Einstein has said, every scientific theory can be, and needs to be, merged in a higher and more comprehensive theory from which it finally receives its limits.

On the other hand, if the limitations of science are now more clearly perceived, it is also true that the tacit assumption behind the whole of scientific knowledge—that knowledge is possible concerning an objective set of facts, in other words, that there is such a thing as truth—has become more and more unassailable. We are indeed leading up to a final condition of physics in which all past discoveries are comprehended in a single unitary logical structure which is independent of the various possible methods of approach.

An outstanding feature of the present position is that we are now able to state very exactly where lie the problems still to be solved, and the chances of a really fundamental new discovery by random experiment or purely speculative theorising are well-nigh negligible. All really great theoretical and experimental discoveries of the last decade have been made by trained specialists, and in the main by men who had long reached the highest eminence in science. This position does not indeed entitle us to believe that investigation in this field is likely to become stagnant. It may, on the contrary, begin deductively in greater earnest. It does, however, provide some real explanation of the strong plea for the concentration of effort on the human sciences, where the greater complexities have delayed advance to a comparable extent and where the true laws have largely to be discovered.

To grant this is not to concede that the sole object of science is to understand the present state of affairs ; its goal is rather the whole course of events in the past, present and future. What is clear to even the most casual observer is that man's development has been unbalanced. His knowledge of physical laws and his control over physical forces is out of all proportion to his knowledge of biology or of the sciences concerned with man, still more with the growth of ethics and morality. For example, it is well known that there are inherited differences in cultural endowment among the members of a people, and these endowments are on an average proportional to the social level of the various layers. It is equally well known that in all modern civilised nations the relative increase in population is inversely proportional to the social level. The corollary that the civilised European nations are allowing their leading cultural elements to die out is, however, not generally faced. Few grasp the extent to which our modern social, hygienic and educational measures promote the well-being of the individual at the cost of humanity. The future of the world lies with the race that is the first to apprehend the true causes of cultural decay and to resolve to eliminate these causes.

At this point we touch an ideal characteristic of our modern Western civilisation—the technical ideal of fitness for a purpose for its own sake. This ideal, as distinct from mere utility, is behind much of the opinion urging the rationalisation of industry, the movement for scientific management, for scientific administration. It is in the direct succession of the ideal of pure science, the discovery of truth for truth's sake—a late conception in the development of humanity. In the technical ideal the fact that elimination of waste of material or effort, for example, in bridge building, involves a saving in cost is purely secondary if not irrelevant. Construction to fulfil the technical ideal must achieve the best possible result with the least possible means. To state, therefore, that technology demands the fulfilment of a purpose by the most suitable means and that quite commonly it consists in the choice of the correct means to achieve that given end, is to realise the immense significance of technology for every side of our social life to-day and the value of liberating it from a mere pecuniary conception of the principle of economy.

It is incontestable that, even in this narrow sense, technical progress has been of immense economic advantage to the world and has raised the average standard of living very considerably. Moreover, the regrettable results of industrialisation and the mechanisation of industry are less the direct responsibility of technology than of economic developments connected with particular technical achievements. None the less, profound problems are raised at this stage. It is possible that wise statesmanship may yet avert the worst consequences of such economic developments by foresight and appropriate action. In particular, there is the problem of leisure and how far it can be utilised to balance the mechanising influence of work and those other influences which perpetuate or increase the ratio of undesirable work.

The whole effect of technology upon our spiritual and mental life has yet to be examined. Once we accept the facts that the advance of science, both pure and applied, and the command of man over Nature cannot be resisted, we are compelled to face the problem how such developments can be made to conform to the elementary spiritual needs of mankind, which themselves cannot be abolished by simple decree.

Aeroplane and Camera in Anthropological Fieldwork

Äthiopen des Westens : Forschungsreisen in Portugiesisch-Guinea. Von Hugo Adolf Bernatzik. Mit einem Beitrag von Bernhard Struck. Band 1. Pp. xii + 303 + 12 plates. Band 2. 152 plates. (Wien : L. W. Seidel und Sohn, 1933.) 135 gold marks.

TO state that "Äthiopen des Westens" is a sumptuous production is not to exaggerate the lavish feast which this beautifully produced work unfolds to the eye. To write that the 531 plates—400 of which form the sole contents of vol. 2—comprise the *pièce de résistance*, is not to belittle the narrative matter which constitutes the greater part of the text of vol. 1.

Dr. Bernatzik has summoned the camera and the aeroplane to be his interpreters in his successful attempt to portray the life of the inhabitants of little-known Portuguese Guinea. The result is, very literally, a vivid series of pictures of the peoples among whom he travelled. Prof. Struck's contribution supplies—what may have been deemed the necessary—more strictly scientific touch. It deserves special notice which it will presently receive.

This must surely be the first occasion—if we omit Lady Bailey's survey flights in North Africa, and the solo flight over the Gold Coast of a professional anthropologist in 1929—upon which the aeroplane has been called in to assist the anthropological field-worker. Perhaps only those who know the ever present and dread possibilities of forced landings when flying over tropical forests, can fully appreciate the skill and courage of the airwoman, Fraulein Elli Beinhorn, which made possible the many bird's-eye views of native houses and homesteads. Dr. Bernatzik's methods were, throughout, simple and straightforward. Handicapped by a lack of knowledge of the local vernaculars, he was compelled to rely more on what he could himself observe than on what he heard or was told. He has taken each of some dozen tribes in turn, and under such headings as religion, birth, marriage, funeral rites, dances, law, love-making, etc., has described what any trained and careful observer would be likely to see with his own eyes. He has then recorded these sights and scenes with the aid of an artistic wife and of a fine camera. The rites and customs which he describes exhibit many of the features which we are now beginning to find common to most West African primitive societies, the more we come to know about such communities. Ideas on land tenure ; law ; standards of morality, where the desire for children far outweighs any narrow jealous feeling of sexual prerogative on the part of a childless spouse ; the absence of chiefs—in the narrower territorial sense—all these and many other customs described are found among other west coast peoples.

One statement, however, made by Dr. Bernatzik seems so extraordinary as to merit some doubt as to whether he has not either been misinformed or misled. He writes, speaking of the Balante, that they do not believe in a life after death ; that they do not follow the cult of ancestor worship, that they do not fear the dead. All this, too, in West Africa, where the cult of ancestors is the keystone of all religious beliefs. It seems well-nigh impossible.

The reviewer was struck with the old priest's description of a great tree which had withstood a forest fire for twenty days, standing up when all around it had been destroyed, "a mighty glowing column", thus justifying and augmenting its previous claim to divinity. The story recalled vividly a similar spectacle which the writer once saw in West Africa. Wandering in the forest one misty morning, he saw through the harmattan haze an immense column of incandescent radiance, towering some 250 feet into the sky. The sight was so wonderful and uncanny as at first to inspire a feeling akin to awe. This strange phenomenon proved, however, on closer inspection to be only a gigantic tree, which from base to summit was a white-hot mass of glowing charcoal. It emitted neither smoke nor sparks but shimmered with a white heat. After witnessing such a sight, it is not difficult to understand how a blackened tree stump may have become a pagan god.

Reference has already been made to Prof. B. Struck's contribution to this work. His chapter on physical measurements may be said to supply the more strictly scientific background for Dr. Bernatzik's more simple narrative and wonderful pictorial setting. The social anthropologist has here asked the physical anthropological expert to come to his aid in order to do full justice to this important part of the work under review. Dr. L. H. Dudley Buxton writes as follows:

"Prof. Struck's contribution to the physical anthropology of this region, which is little known, is a very important one. The author gives a careful reference to the methods used—a precision unfortunately only too rare. He always prints the numbers of the definitions given in Martin's 'Lehrbuch'; in particular, he directs attention to the question of the position of the nasion, in which case Martin's method is adopted, it would appear, with some reluctance. On this very important point, for the nasal index is extremely significant in many parts of the west coast, the author seems satisfied on internal evidence, namely, the comparison between the various groups, that he was working consistently with others in the field. To the critic who is constantly faced with the doubt as to whether the work of different observers is comparable, Prof. Struck's paper is for all these reasons extremely welcome.

"There are, however, some points to which criticism may be fairly directed. No one knows better than the field-worker how very difficult it is to get adequate numbers of subjects, and in most cases the author's groups are sufficiently large for satisfactory comparison. On the other hand, it would be a hazardous undertaking to base any conclusions on the comparison of groups which contain only a few individuals; it would perhaps have been safer with our present knowledge, either simply to publish the means of the smaller groups without drawing any deductions, or, where it is possible, to use the method followed in the case of the Balante and Pepel and to pool the subgroups, where there is reason to believe that such a pooling is justifiable. Next, it would seem inadequate merely to publish means; the constants of variation and probable errors should certainly be added, especially where comparisons between individual measurements are made. The author's method is to consider each measurement individually, and to compare the various tribes.

"Much as one might have wished for a general summary, obviously the material was inadequate for this and the restraint of which this absence is evidence is not the least commendable part of a paper which should be of very great value to all students of the physical types of West Africa."

R. S. R.

The Trinkler Expedition to Central Asia

Geographische Forschungen im westlichen Zentralasien und Karakorum-Himalaya. Von Dr. Emil Trinkler. (Wissenschaftliche Ergebnisse der Dr. Trinkler'schen Zentralasien-Expedition, bearbeitet von Dr. E. Trinkler und Dr. H. de Terra, Band 1.) Pp. viii+134+16 plates. (Berlin: Dietrich Reimer (Ernst Vohsen) A.-G., 1932.) 32 gold marks.

Geologische Forschungen im westlichen K'unlun und Karakorum-Himalaya. Von Dr. Hellmut de Terra. Mit Beiträgen von G. Fischer, W. Gothan, P. Vinassa de Regny, O. H. Schindewolf, J. Schuster, K. Staesche. (Wissenschaftliche Ergebnisse der Dr. Trinkler'schen Zentralasien-Expedition, Band 2.) Pp. x+196+22 plates. (Berlin: Dietrich Reimer (Ernst Vohsen) A.-G., 1932.) 44 gold marks.

THE name of Dr. Emil Trinkler must be added to the growing list of those who, having risked health and life itself in the cause of science in distant lands, have fallen victims to the perils of modern civilisation. T. Alexander Barns, after years of exploration in Central Africa, was killed in a motor accident in Chicago; Dr.

Trinkler, after such narrow escapes from disaster in the uninhabited Kunlun as when all but one of his yaks perished, also died as the result of a motor accident—in Bremerhaven in April 1931. He was but a young man of thirty-five years when he died but he has left behind a record of solid work which will remain as an important contribution to the elucidation of the structural and morphological history of the Karakoram, Kunlun and Taklamakan regions.

Dr. Trinkler first became prominent as having made a lengthy tour through Afghanistan in 1923. He showed himself a man of resource in travel and of sound ability in the marshalling of facts and sifting of evidence collected by his predecessors. As a result his "Afghanistan, eine landeskundliche Studie" (J. Perthes, Gotha, 1928) is a standard work on the country. His second and more ambitious journey, undertaken in 1927–28, was preceded by a careful study of the work of previous explorers in the Eastern Karakoram, and so he was able to select a region that had been comparatively neglected. From Leh in Kashmir he followed an eastern route across the western end of the Tibetan plateau to the Kara-Kash River; over the Kunlun to the Taklamakan depression. After considerable journeys there he returned to Leh by the better-known route of the Karakoram Pass. By choosing this circular route the geological results include a complete double traverse of the Karakoram and Kunlun chains, whilst the leader was able to make a special study of one of the problems he regarded as of special interest—the history of glaciation in this region.

Dr. Trinkler wrote a popular account of his journey, "Im Land der Stürme" (F. A. Brockhaus, Leipzig, 1930) and a number of technical papers. The latter include two in English—his conclusions relative to the Ice Age (*Geog. J.*, 75, 225–232; 1930) and a general account of his journey (*Ibid.*, 75, 505–517; 1930). His detailed account of the geographical observations was almost ready for press at the time of his death and so has appeared posthumously, edited by Frau Ilse Trinkler and G. Köhler. For this thanks are also due to Dr. H. de Terra, the geologist of the party, who was a fellow student of Trinkler's at Munich and is now research associate in geology at Yale. Simultaneously, Dr. de Terra has published his geological observations; the archæological results of the expedition, which are being worked out in the Bremen Museum, have still to appear.

(1) The geographical volume is divided into two parts. The first deals with the mountain belt between the Upper Indus valley at Leh and the Tarim Basin; the second with the western part of the Tarim Basin itself. In the first part the features observed on each stage of the journey are described in sequence with the help of sketches and photographs. A number of the latter are by W. Bosshard, a Swiss, who formed the third European member of the expedition. Special attention is given to morphology and a contrast drawn between the accidented topography of the Tertiary ranges and the round outlines of the hills which rise from the surface of the Tibetan plateau.

It is a legitimate presumption that when the great Ice Age covered the whole of Northern Europe and the northern parts of Northern America with ice sheets, Central Asia should also have been the seat of a huge ice-sheet. A review of the evidence leaves no doubt that the glaciers of the Kunlun, Karakoram and Himalayas were formerly much more extensive. Dainelli, who accompanied the Italian expedition led by De Filippi in 1913–14, found evidence in the Karakoram for four great glacial periods corresponding with the Mindel, Riss, Würm and Post-Würm stages in the Alps. Although the moraines of the first two glaciations are poorly preserved, Trinkler does not appear to doubt this interpretation. He considers that during the later glacial periods the snow line was 2,000–3,000 ft. lower than at present and that glaciers descended in the Kunlun to 8,000 ft. or 9,000 ft. above sea-level. It may even be that Dainelli is right in believing that the big Indus glacier ended with its snout in the lake which formerly occupied the Attock plateau of the Punjab at less than 2,000 ft.

Whether the great Tibetan plateau, the roof of the world, was covered by a huge ice-sheet is, however, another matter. The temperature was, of course, low enough, but did not the southern ranges—the Himalayas—intercept the moisture-laden winds just as they do to-day and prevent sufficient precipitation? Trinkler admits that striated boulders and polished rocks are extremely rare, but points out that disintegration of exposed rocks is very rapid owing to the strong insolation. Further, typical V-shaped valleys are absent on the plateau. Trinkler therefore comes to the same conclusion as Prinz did in the Pamirs, that the broad valley-plains of the Tibetan plateau were more or less filled with *stagnant Tafeleis* (Highland ice) which left little trace on melting. Only on the margins where movement was possible did it carry out the work of erosion characteristically associated with ice-sheets. In connexion with precipitation on the plateau, it is interesting to note that Trinkler asserts positively that the Indian monsoon penetrates far into the interior, though winter snowfall is also brought by depressions from the west.

(2) Dr. de Terra has secured the collaboration of a number of experts in preparing his volume on the geological results of the expedition. He gives a brief introductory outline enumerating the orographic units and then proceeds to a detailed account of his observations. Especially valuable are the numerous sketches and simplified block diagrams illustrating the relationships between structure and topography. A coloured map on the scale of 1 : 1,000,000 is included and on p. 112 the author attempts two generalised sections from Leh to the Kunlun. Three distinct belts stand out clearly : (1) the highly folded Himalayan-Mustagh or Karakoram belt in which gneisses, schists, metamorphosed older Palæozoics and intrusive granites predominate ; (2) the highly folded Kunlun belt where again gneisses and granites play a very large part ; and (3) the intervening belt of plateaux in which gently folded Triassic limestones predominate but where younger Palæozoic (Carboniferous-Permian) as well as Cretaceous rocks are also present. The last belt formed part of the Tethsy until late Cretaceous times.

There is, of course, an important distinction between the Himalayan fold-belt in which Tertiary rocks are involved and the Kunlun fold-belt, folded and uplifted in Permian times. The old Kunlun system, Dr. de Terra discovered, is separated from the geologically younger folded regions of the Tibetan plateau by a belt of faulting which is marked by a broad plain-like valley running along the southern foot of the main Kunlun range. In general, both in the Kunlun and Karakoram, tectonic and orographic strikes correspond.

The latter part of de Terra's volume is occupied by a description of hand specimens and fossils. Both Dr. Trinkler and Dr. de Terra have much of interest to add to what is already known of the Taklamakan, but their contribution to the knowledge of the mountain wall which separates India from Chinese Turkestan is of outstanding importance.

L. Dudley Stamp.

Hydro- and Aerodynamics

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 4: *Hydro- und Aerodynamik.* Teil 4: *Rohre, Offene Gerinne, Zähigkeit.* Herausgegeben von Ludwig Schiller. Bearbeitet von L. Schiller, F. Eisner, S. Erk. Pp. viii + 719. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932.) 67 gold marks.

THIS fourth and concluding volume of the part of the "Handbuch der Experimentalphysik" devoted to the subject of hydro- and aerodynamics fully maintains the high standard set by the three preceding volumes. It comprises three long articles dealing respectively with the flow in pipes, the flow in open channels and the measurement of viscosity, and it also contains a useful general index to the whole four volumes.

The first article, by Prof. L. Schiller, is noteworthy for its critical discussion of the subject and for its clear exposition of both the theoretical and experimental investigation of the flow in pipes. The work of Schiller himself and that conducted under his direction at Leipzig have contributed greatly to our knowledge of this subject and in particular to a proper understanding of the influence of different entry conditions and their effect on the pressure loss along a pipe. After a clear exposition of the principles of dynamical similarity and of the precautions necessary in the measurement of velocity and pressure, Schiller discusses in turn the laminar and turbulent flow in circular pipes and transition from one type to the other. An excellent and valuable summary of the best experimental results is supplemented by a discussion of the latest theoretical developments, in which turbulent flow is analysed on the basis of Prandtl's conception of a *Mischungsweg*. The article concludes with relatively brief discussions of the flow in non-circular, divergent, curved and rough pipes.

The flow in open channels is discussed by Dr. F. Eisner in the second article. This subject is far more complex than the flow in pipes owing to the presence of the free surface, the conditions for full dynamical similarity are more complex and indeed prevent any exact model experiments, and the problems tend to assume a practical engineering rather than a scientific aspect. After a rather tedious discussion of the conditions of dynamical similarity, Eisner gives a valuable account of the experimental technique and apparatus with special attention to the determination of the form of the free surface. This is supplemented in a later section by descriptions of the ingenious devices used for creating tides and waves. The major part of Eisner's article is, however, devoted to a detailed description of experimental results covering a wide range of subjects, and particular mention may be made of his excellent account of wave motion.

The third article, by Dr. S. Erk, deals with the measurement of viscosity. Numerous types of viscometer, suitable for different fluids and different experimental conditions, are fully described, and the experimental results for a large variety of gases and liquids are then tabulated and discussed in the light of existing theories. The article concludes with a brief account of the methods of measuring the viscosity of solid bodies. The treatment of the subject is throughout clear and comprehensive, but there are unfortunately several incorrect references to tables and figures.

A Treatise on Coordinate Geometry

Elements of Coordinate Geometry. By J. M. Child. Pp. xiii + 468. (London: Macmillan and Co., Ltd., 1933.) 12*s*. 6*d*. net.

THE outstanding feature of this substantial treatise on coordinate geometry of two dimensions is the full and elaborate account which it gives of the theory of the subject. In consequence, the volume should prove a useful manual for students preparing for scholarship and honours degree examinations.

The first chapter contains a discussion of the representation of real numbers by points on a directed line; and this, naturally, raises the problem of the irrational number, which Mr. Child defines by means of sequences of rational numbers. Curiously enough, he does not point out that the number so defined may be rational. It must be confessed that his phraseology in dealing with limits is somewhat loose.

Before introducing the equation of the straight line, Mr. Child devotes a chapter to the plotting of statistics. He defines the positive direction of the straight line as that in which x increases. It is doubtful if anything is gained in coordinate geometry by giving direction to the straight line. The direction makes no difference to the gradient formula, on which the theory of the straight line can most simply be based.

Useful features of the book are the very full discussions of the general equation of the second degree and the sections on polar coordinates. The treatment of tangents, based on the theory of monotonic sequences, is interesting, though it scarcely seems necessary to bring in the idea of 'time'.

Later chapters deal with conics, cross-ratios, the "line at infinity" and homogeneous coordinates. The book is intended to stress the advantage of coordinate geometry as "a powerful analytical weapon of attack" and consequently the pure geometry of conics is only dealt with incidentally. Here and there interesting historical notes are given, and there are plentiful collections of examples, of varied difficulty, with answers supplied.

T. M. M.

Short Reviews

The Life Histories of New Zealand Birds. By Edgar F. Stead. Pp. xvi + 162 + 93 plates. (London: The Search Publishing Co., Ltd., 1932.) 30*s*. net.

IN this book we have Mr. Edgar F. Stead doing for New Zealand birds what Mr. Arthur C. Bent is doing for American birds. Each is an expert and the result is a great gain to knowledge.

In New Zealand we find the evil of man's introduction of the stoats and weasels. The birds, which never before had this enemy, now find life made hard for them. Amongst the waders we find a detailed account of the double-banded dotterel, so common in New Zealand and Australia, but breeding only in the former country. Its migration, north to Norfolk and Lord Howe Islands then to the east coast of Australia and so on to south-west Australia, is one of the extraordinary movements amongst birds.

We find now that the black fan-tail is only a variant of the pied one; mated birds produce the pure black bird and in the same nest, pied birds, as many workers have contended.

Under the shags we find the old superstition that these birds are the fisherman's enemy and destroy fish that he should catch. New Zealand has many shags, most of them very common indeed, yet more fish are caught each year than in the previous one. The skua, with its bad reputation, here as elsewhere, is given an autobiography in spite of its depredations on the delightful mottled petrel.

The splendid plates add greatly to the charm of the book, and the author's pleasant style of writing will attract the reader, who will be interested and instructed while reading the book. It will be a useful and necessary companion to Oliver's book "New Zealand Birds" which we reviewed last year. At the end of the book is a description of the eggs of the eighteen species of which the life histories have been described.

Handbuch der Vererbungswissenschaft. Herausgegeben von E. Baur und M. Hartmann. Lief. 15 (Bd. 3, L): *Entstehung der Kulturpflanzen.* Von E. Schiemann. Pp. ix + 377. (Berlin: Gebrüder Borntraeger, 1932.) 50 gold marks.

This textbook endeavours to present a comprehensive review of the origin of cultivated plants, considered from the historical and biological points of view. The preliminary general discussion deals with our historical knowledge of the various crops, after which comparative morphology, geographical distribution and genetics are considered in their relation to crop plants. The range of the inquiry is wide, embracing in addition morphology, physiology and problems of variability. Where a crop plant occurs in both wild and cultivated forms, it is pointed out that its origin is usually to be sought where the wild type occurs.

Individual crops receive separate treatment, most of the common agricultural plants such as cereals, potatoes, Leguminosæ, etc., and a few of the more important horticultural crops as tomatoes, fruit, grapes, etc., being discussed in detail. A full bibliography of some twelve hundred titles, and tables giving a general summary of the main results, round up a most useful work of reference.

The Gestalt Theory and the Problem of Configuration. By Bruno Petermann. Translated by Meyer Fortes. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xi + 344. (London: Kegan Paul and Co., Ltd., 1932.) 15*s.* net.

Among the psychological theories, the doctrine of *Gestalt* or 'configurationism' has won general attention only recently, though it grew contemporaneously with behaviourism. Its importance, however, is none the less very great in so far as it furnishes an alternative approach to the psycho-physiological problem of human and animal behaviour. The general conception of 'configurationism' is to stress organised wholes as they occur in experience and in performance rather than their elements, as does the older psychology. This method makes possible an alternative treatment of behaviour, of perception and even of learning, though the results obtained in this respect are not yet final. The particular value of the book under review is that it not only explains the aims, method and results of the *Gestalt* theory, but that it also makes a searching criticism of this doctrine, indicating at the same time the conditions for its future progress.

T. G.

Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Frank C. Whitmore, Editor-in-Chief. Vol. 12. Pp. vii + 96. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 10*s.* 6*d.* net.

The latest volume of this series contains details of the preparation of thirty useful substances. Among them are *p*-chlorobenzaldehyde, *p*-tolualdehyde, desyl chloride, succinic anhydride, mercury di-β-naphthyl, and diethyl zinc. The preparation of 2,4-dinitrobenzaldehyde (a reagent of value for characterising amines and substances with a reactive methylene group) is a particularly interesting process, depending upon the reaction between *p*-nitrosodimethylaniline and 2,4-dinitrotoluene, whereby the methyl group of the latter substance is eventually transformed into an aldehyde group, leaving *p*-aminodimethylaniline as a by-product.

This issue is the third volume not embraced in the recent collective work, and it is therefore useful that the index to vol. 12 has been extended to cover the contents of vols. 10 and 11 also.

J. R.

L'Année psychologique. Publiée par Prof. Henri Piéron. Année 32 (1931). Vol. 1. Pp. xx + 480. Vol. 2. Pp. 481–949. (Paris: Félix Alcan, 1932.) 120 francs.

As usual, this yearly publication contains some very important original essays and a mass of reviews (1,670 in number) of the current literature of psychology. It will suffice to mention some of the subjects treated: chromatic sensation (Piéron), mental work without movements (Foucault), nervous rhythms and relaxation oscillations (Fessard), complexity of consecutive visual impressions (Durey), appreciation of time in the white mouse (Ruch). At the end of this work there is an appeal by Prof. Spearman, to the effect that psychologists should agree once for all about the conditions and interpretations of certain experiments, on the lines followed by physicists.

A French-English Vocabulary in Geology and Physical Geography. By G. M. Davies. Pp. ix + 140. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1932.) 6*s.* net.

This vocabulary contains between four and five thousand words. Most of them are either technical terms or words in common use which have special technical or colloquial meanings. The inclusion of the English equivalents of a number of unfamiliar place names adds to the usefulness of the vocabulary. An appendix contains a comparative table of English and Continental stratigraphical terms. The lack of such a glossary as this, devoted especially to geology and its allied sciences, has long been apparent. It should prove invaluable to many English readers of French works on geology and geography.

Agriculture and Milk Supply[*]

By PROF. HENRY E. ARMSTRONG, F.R.S.

"Nought shall make us rue
If England to itself do rest but true."

WE take our time in minding the Bastard's advice—concerning ourselves more with Far Eastern questions than with our own, even with such minor, polar moments as hard hitting above the cricket belt and dog totes. In fact, our one popular use of our land is playing games upon it: also as gladiators but upon rubber tyres and oil-fouling our tracks as we go, mercilessly and without turning down of thumbs running each other down, under sanction of third party insurance! Those who set themselves over us, by right of caucus, have long ceased to think of the land in constructive, sympathetic terms or otherwise than as affording opportunity for the *greatest of all games—taxation!* Agricultural research is become an underground business, with little interest in sun-bathing; dealing with bacteria mostly—a form of life to which, ultimately, we must all succumb. In Egyptian times, some care was taken of our bodies—to-day we are simply handing them over to commercial exploitation: to universal undertakers called canners. We calmly cut our food not from the joint with two vegetables but out of sealed 'coffins'. Fresh food will soon be unseen and unsold! Health must steadily deteriorate. We call the game we are fatuously playing—Progress; perchance, the name will ere long perforce be changed to Perdition. Well may we ask with Bunthorne:

"Is it and can it be
Nature hath this decree
Nothing poetic in the world shall dwell?"

Nothing natural? Is our agriculture coming to an end?

The issue I would raise is—*Are we to use our land to produce fresh whole food—to make ourselves a whole people, our animals whole stock?* Alternatively, are we to allow tubercular disease, cancer, appendicitis, foot and mouth—deficiency diseases generally—to ravage our population? Malnutrition to prevail everywhere? Is our land to be highly fed and used up to the hilt of production and employment or is it to go derelict—to favour machinery and commercial lust? Many industrialists would calmly put the countryman aside—just use him to keep the hedges trim; so that they may sell their wares abroad, they would allow unconditional free entry to other people's farm products without reference to quality. Such form of civil war is even looked upon as a means of cementing family ties: it was at Ottawa. In the sacred name of Imperial Preference, we are to allow our wheat to be grown in Canada and Australia, our milk to be made in New Zealand! Our eggs and butter also at the Antipodes. As to meat, we help in every way its introduction into our markets, in merciless competition with that raised upon our own soil: under the ægis of the Department of Scientific and Industrial Research, public funds are lavishly spent on the study of the means of preserving it and other food, so that they may be brought to us from long distances. Home produced food materials receive little scientific attention.

The fault lies with our own fraternity of science, in that we have in every way aided commercial, industrial development, without considering the ultimate effect upon the general welfare. No proper social use has been made of knowledge—the national education has been and still is in the hands of people who have no eyes to see and but play with words: the Head of Eton becomes Dean of Durham. We are still under monastic rule.

"New times demand new manners and new men." The cry was uttered long ago by an American advocate of freedom. The men who would lead the world to-day are old and without any manners that are new: they have no regard for the method of discovery—the one gift the world has received in modern times; unfortunately, by unrighteous and partial use the gift has brought the world to its present intolerable position.

A decision must soon be taken—what proportional share and part agriculture is to have in our social economy. That we must play the game with our land cannot be denied. It is the only ultimate asset we shall have, as an island people, if and when all else fail us. To maintain a fit and happy race, we must needs preserve a rural population. Prices must be established at such agreed levels that we can make most use of men and least use of machines. It cannot be that we shall sink so low, through commercial avarice and worship of the unholy doctrine of always buying in the cheapest market, that we shall decline to use to the full the great God-given machine that we have in the sun. Chemistry forbids: the forgotten law of the conservation of energy. Manufacturing industry is but dissipation of energy, when carried on with coal.

To-day, the chemist can have but one opinion, if he consider the needs of the world. This is, that the first use we make of our science—of scientific method—should be on behalf of our food supply, in farming. Thus far, the farm has been considered from the point of view of a far too narrow economics—commercially and statistically, in terms of output. So great, however, has been our progress in the scientific study of food problems, especially during the past twenty years, that we are now able to envisage the place and object of agriculture from an entirely new angle: *that of nutritive value.* We know that malnutrition prevails the world over.

The future fulcrum of our agriculture must undoubtedly be milk—the food of foods, the food of infancy, the one and only complete food known to man. America is far ahead of Great Britain in its appreciation and use of milk. Here, the medical profession has never properly encouraged its use —being so deadly afraid of the organism provocative of tubercular disease. There has been no public opinion on the subject and too little attention has been paid to quality: although, of late, there has been a marked improvement, none the less, the average quality is far too low.

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[*] Ministry of Agriculture and Fisheries. Report of the Reorganisation Committee for Milk. (Economic Series, No. 38.) Pp. 228+xx. (London: H.M. Stationery Office, 1933.) 6*d*. net.

So far are we from being alive to the need of using scientific method and knowledge in the service of the State, that only laymen were appointed by the Ministry of Agriculture, as members of the special commission the Report of which on the Reorganisation of the Milk Supply has recently been issued. Only commercial organisation is considered, though measures against the spread of disease are recommended: these involve the appointment of fresh veterinary inspectors, doubtless with power to order the slaughter of infected animals. Hitherto, the Ministry of Agriculture, unfortunately, has had only one remedy in mind, in dealing with cattle disease—to kill. If it had charge of the community, it would re-Herod Herod and order all children with measles to the destructor—as it does cattle with foot and mouth disease. Preventive vaccine treatment also is at best a palliative. We need to put Pasteur aside and start afresh: having learnt something since his day, the time is come to go forward with constructive ideas of our own. The more we rely on pasteurisation, the less we are likely to go forward with measures to place our milk supply upon a scientific basis.

It is useless to shut the stable door after the steed is stolen, even in dealing with tuberculous cattle. Assuming that the organism were gone from milk, the ever-present far greater danger of the pulmonary form of the disease would remain. It is impossible to kill off the contacts: you can only cure victims at high cost—but how? Definitely, by high feeding!

Why not apply the cure to prevent the disease? The one chance of eliminating tubercular and other zymotic diseases seems to be to feed them out—both from cattle and ourselves. Let us seek to feed both our cattle and ourselves with whole food, rich in all the advitants. We know that there is disease whenever one or more of them is absent. In one region in New Zealand the animals suffer from a recognised deficiency in iodine: in another, from lack of iron. Ours often suffer from want of available iron; in sandstone regions especially the effect of a deficiency of lime and perhaps phosphate is particularly noticeable in the poor development of the horns; calcium is undoubtedly lacking over large areas. Australian and South African soils are known to be greatly deficient, particularly in phosphate, potash and lime. The produce from these countries must often be deficient in quality, on this account.

Proof has been obtained, from numberless experiments on animals, that health is greatly influenced by feeding and that properly fed animals are little if at all subject to bacterial infection. Minor deficiencies may not be easily followed up but, in the long run, their effect may be deep seated. The experiments made with pasteurised milk are all suspect, if only on this account; valid results cannot be obtained with children. Just as milk has been taken to be worthy to be called milk, if only it came from a cow, even from a tuberculous animal, after pasteurisation: so grass was long taken to be grass, if only a cow would eat it; only when it came to fattening animals, was a distinction made. The most important of all cereals, grass has been the least studied: no imagination has been put into the foundations of milk. The Rothamsted plots, however valuable botanically, have taught nothing of grass as a fodder crop. All we know is that grass needs to be treated as well as wheat. Not until the War and in Germany was inquiry directed to the use and special value of nitrogenous fertilisers on its growth. The great value of young grass was then brought to the fore.

In the last few years, inquiries into the growth and use of grass have been carried out in various parts of England, for the production of milk, under the direction of Sir Frederick Keeble, formerly professor of botany at Oxford. The results are in part described and discussed in his book "Fertilizers and Food Production on Arable and Grass Land", a work of great interest, nothing short of a revelation of grass.

One of the most significant results is that obtained last year by the winter feeding of cows with grass, cut young in the summer and forthwith rapidly dried, the grass being taken from pasture fully fertilised with minerals and also with an ammonia salt. Comparison was made with a grass from an adjoining pasture to which no nitrogenous manure had been applied, only minerals. The milk from the cows fed on the 'nitrogenous grass' gave a butter of full summer value in appearance and character; the butter from 'minerals only' was but slightly better than the poor product ordinarily obtained from stall-fed cattle. The result is as striking as that shown at Rothamsted on the celebrated Broadbalk Field, on the two plots, both fully dressed each year with minerals, one or the other only receiving nitrogenous fertiliser each year. Without nitrogen, the crop each year goes down nearly to the level of the nearby permanently unmanured plot.

During last winter, I was able to initiate an experiment with young boys, with the object of determining whether milk, produced with the aid of such summer-cut dried grass, be of special food value compared with the ordinarily 'stall-fed' milk. It is too early to pronounce upon the result but I have been astounded at the way in which the cattle fed upon the dried grass are 'swelling wisibly', like 'the Fat Boy', in comparison with their neighbours. The carotene content of the milk is at a high level. Who shall say what other components may not be equally affected? It is impossible to believe that improvement is in one necessary component only.

With such evidence before us, the way is clear: selfishly, to care for our cattle as much as we care for ourselves: in fact, through them really to care for ourselves, particularly for our children. Housing is of no importance compared with proper feeding.

The supreme value of milk is beyond all question—particularly to the pregnant mother, to the child from the moment of conception, throughout infancy and early youth. Our task now is to make the general supply of such quality that it may serve as a defence against all disease arising in any way from a lowered vitality in ourselves or in farm animals generally from imperfect feeding.

Our cry should be not merely: 'Back to the Land' but 'Honour the Land', by raising its fertility to its fullest extent and enjoying the fruits thereof.

The Indian Institute of Science, Bangalore

THE retirement of Dr. M. O. Forster last month from the directorship of the Indian Institute of Science, Bangalore, after ten years service, and the appointment of Sir C. V. Raman to succeed him, afford an appropriate opportunity to give a general account of this remarkable Institute and its work. In recent years the number of workers in the various departments has greatly increased, and many of the researches carried out by them are of high scientific value, while others have a direct bearing upon the development of the country's natural resources and industrial expansion. There are four scientific departments in the Institute, concerned respectively with general chemistry, organic chemistry, biochemistry and electrical technology, and the range of investigations carried on in each of them is very wide.

Dr. Forster himself is to be congratulated upon the continued progress of the Institute during his directorship and the maintenance of the object for which it was established, namely, to promote original investigations and their use for the benefit of India. His services to the cause of higher scientific education and research in India are widely known and highly appreciated. A remarkable testimony to the regard in which he is held at Bangalore, and a tribute of gratitude from the staff and students of the Institute, were afforded by a large and distinguished company which assembled at the Institute on March 14 to express regret at his departure and convey the best wishes to him and Mrs. Forster. Dr. Forster was presented with an address and a silver casket of exquisite workmanship, and Sir Mirza Ismail, Prime Minister of Mysore, who presided, referred in glowing terms to his zeal and devotion to the Institute. In the course of his speech, Sir Mirza said: "Dr. and Mrs. Forster have come to love this State as much as we do. They have identified themselves with us completely. I need not tell them, for I am sure they know it well enough, that their decision to continue to live amongst us, after retirement, is a source of the utmost gratification to their friends and even to those who are not privileged to know them personally. We feel that we shall be enriched by their presence in our midst. . . ." As Dr. Forster is retiring to the beautiful garden city of Mysore, which is only a couple of hours journey from Bangalore, he will be able to continue in touch with the Institute and its activities.

The Institute originated in the munificence and foresight of Mr. Jamsetji Nusserwanji Tata who, about the year 1896, proposed to place in trust Bombay properties with a capital value of Rs. 30 lakhs (£225,000) to endow a research institute for India. During the development of a scheme for implementing this benefaction, the Government of Mysore allocated 371 acres of suitable property about three miles from the outskirts of Bangalore, contributed Rs. 5 lakhs (£37,500) towards the buildings and promised a subsidy of Rs. 50,000 (£3,750) per annum without limit of time: while the Government of India agreed to make an annual grant of Rs. 1·5 lakhs (£11,250).

On the death of Mr. J. N. Tata, his two sons, the late Sir Dorabji and Sir Ruttonji Tata, announced their intention of giving effect to the wishes of Mr. J. N. Tata, and transferred the Bombay properties to the Treasurer of Charitable Endowments. The vesting order having been signed in May 1909, the Council appointed thereunder authorised the construction and equipment of the buildings already planned by Dr. M. W. Travers, who had been appointed director in August, 1906. The first students were admitted to the departments of general chemistry, applied chemistry and electrical technology in July 1911, the department of organic chemistry being opened in September of the same year.

It was hoped by Sir Dorabji Tata that the Institute would become an all-India institution, and this intention is to some extent realised by the students in it being drawn from all parts of the sub-continent, though for geographical reasons those from Mysore and Madras predominate. On the financial side, however, it cannot be said that the support to the Institute is of an all-India character. Excepting Mysore and Hyderabad, which have uniformly and generously supported the Institute, contributions from other States and Provinces have been altogether disproportionate to the benefits received by their students. Bombay has approximately the same number of students in the Institute as Mysore and Madras, yet it contributes nothing to the finances. The absence of support from Bombay and Bengal is much to be regretted, for it means that other regions are influenced by it and neglect to afford the aid which would make the revenue of the Institute an all-India responsibility.

The following analysis of applications and admissions for the five years 1926–30 shows the geographical distribution, and the considerable excess of applications over admissions from all parts of the country:

	Mysore	Madras	Bombay	Bengal	Rest of India
Applications ..	151	239	244	72	148
Admissions ..	73	88	91	26	51

It was pointed out in an article in *Current Science* of October last that those responsible for developing the resources of the Institute, while placing in the foreground the requirement to impart advanced knowledge, and instruct in the methods of research, have consistently kept in mind any possible bearing which the results may have on the inception of new industries and the improvement of existing ones. Ample evidence of this recurs each year in the appendix to the Council's annual report, showing in abridged form the current subjects of investigation; but although the technological application of the work at the Institute has been wide, and in several cases valuable, there is doubtless room for expansion in this field.

One example of an economic application latterly engaging the attention of the Institute is the systematic inquiry into the cause of spike-disease in sandal. This has now continued during the past five years in co-operation with the Government of Madras and the Coorg Commission, the results being summarised in periodical reports published separately from the *Journal* of the Institute. The latter publication contains a description of the various inquiries, academic and economic, which have been pursued in the laboratories, and in the past fifteen years has comprised about two hundred issues. The range of subjects is wide, and includes many that might be turned to an industrial utilisation of principles or materials. This aspect of the work is reflected in the fact that the major proportion of the Institute's former students have been absorbed into non-academic occupations, particularly in the field of electrical technology.

An estimate of the factors contributing to the growth of the Institute may properly include the following considerations. The original organisation was planned by Dr. M. W. Travers, who served as director from 1906 until 1914, being succeeded in the following year by Sir Alfred Bourne until 1921. On Dr. Travers leaving India after constituting the chemistry laboratories, Prof. J. J. Sudborough became head of the departments of general and organic chemistry, terminating in 1925 his fourteen years' association with the Institute, and having developed a highly efficient department of organic chemistry dealing principally with indigenous natural products. He was ably followed by Prof. J. L. Simonsen, who remained only two years and is now professor of chemistry in the University College of North Wales, Bangor. In 1916, Prof. H. E. Watson, who had rendered excellent service as assistant professor of general and inorganic chemistry since 1910, was appointed professor and is now head of that department, which he has raised to a very high level. On retirement of the late Prof. Rudolf from the chair of applied chemistry in 1914, the duties of that office were assumed in 1916 by Prof. G. J. Fowler, whose reputation in the field of chemical bacteriology led the Council in 1921 to convert the chair into that of biochemistry: this branch he developed in several directions advantageous to India until 1924, when Prof. R. V. Norris was appointed and remained until 1929, making valuable contributions to its activities. Since August of that year Prof. V. Subrahmanyan has been in charge.

Dr. Alfred Hay (who died in April 1932) was appointed as the first professor of electrical technology in January 1908, retiring at the end of 1922. During his fifteen years' tenure he organised an admirable system of training by which engineering graduates of Indian universities are fitted to assume positions of responsibility as electrical engineers. His successor, Prof. J. K. Catterson-Smith (1923–1930), now professor of electrical engineering at King's College, London, greatly extended the premises and equipment of the department, and established a section of electrical communication engineering designed to meet the rapidly expanding interest in wireless telegraphy and telephony. He also founded the Institute Engineering Society, and a journal entitled *Electrotechnics*. In 1931 he was succeeded by Prof. F. N. Mowdawalla.

The *Journal of the Indian Institute of Science* describes the research work issuing from the laboratories, and embraces about two hundred original communications. A preliminary account of these is usually presented at the Indian Science Congress, which has received warm support from the Council by deputations of many students and members of the teaching staff to attend the annual meetings.

An important auxiliary to the work of the departments is the Library, which has been maintained in a state of increasing efficiency by Mr. K. Amrita Row. The library contains 21,000 volumes, principally research journals, and is the best of its kind in India. Research students at Bangalore have thus available for reference the published results of investigations carried on almost anywhere in the world. It is easy to understand, however, that notwithstanding the facilities which the Institute affords for advanced study and research, many students in universities in other parts of India hesitate to undertake post-graduate training there. Even if such an Institute were established in Great Britain, where the distances are not of the same continental order, it may be doubted if it would attract so many science graduates taking courses of advanced study and training for research as are now at Bangalore. Since the Institute was founded there has been a notable increase in the amount of research work carried on in many of the Indian universities, and there is a natural tendency for each such institution to retain its most promising research students instead of letting them go elsewhere.

This and other difficulties in the way of expansion were surveyed by a committee of inquiry, of which Sir William Pope was chairman, appointed in 1921, and helpful suggestions for overcoming them were made in the report of the committee published in the following year. Dr. Forster was appointed director of the Institute shortly after the publication of the report, as a scientific man of eminence with proved administrative capacity, and he has in every way justified his appointment. The committee contemplated the institution of a department of physics as a link between existing activities in physical chemistry and electrical technology, but sufficient financial support has not been afforded to carry out this recommendation. It may be hoped that the new director, Sir Venkata Raman, will by his enthusiasm and untiring energy be able to increase the financial resources sufficiently to establish a new department of physics on a scale worthy of the Institute and of the high expectations of its founder.

Trevithick Centenary Commemorations

During the past week, many tributes have been paid to the memory of Trevithick, the great Cornish inventor and engineer. On April 24 Prof. C. E. Inglis delivered the memorial lecture, at the invitation of the Trevithick Centenary Commemoration Committee, in the theatre of the Institution of Civil Engineers, by kind permission of the council. Sir Murdoch MacDonald, the president of the Institution and the chairman of the Committee, was in the chair.

In beginning his lecture, which is being published in full, with illustrations, in this week's *Engineer*, Prof. Inglis said that when Trevithick died on April 22, 1833, no obituary notices proclaimed that the nation had lost a mechanical genius of the first order of magnitude, and his memory passed into an oblivion which for many years was almost complete. But the greatness of the man, and the impetus he had given to engineering science, was such that his fame could not suffer permanent eclipse. Slowly, but with an ever-increasing luminosity, his genius shone forth, and with the passage of time he seems to rise higher and yet higher above his contemporaries.

Fifty years ago, the name of Richard Trevithick had won an honoured position throughout the engineering world, and now posterity, more discerning than his own generation, deems him not unworthy to be enthroned alongside and on the same exalted plane with his predecessor and one-time rival, the illustrious James Watt.

Trevithick was born at the foot of Carn Brea in the parish of Illogan not far from Camborne on April 13, 1771. Up to about the age of twenty-six years, he was connected with Cornish mining engineering and was familiar with all sides of engineering practice. A man of fine physique, forceful, energetic, self-confident, decisive and independent, he was yet of a kindly, generous disposition and though when goaded by opposition he would flare out, he cherished no animosities and there was a singular absence of anything approaching meanness in his character. The overwhelming vitality and driving force of the man, said Prof. Inglis, is strikingly portrayed in the bronze statue erected in Camborne last year.

Trevithick's great work began with his experiments with steam-driven locomotive models in 1797, and from then until in 1816 he left England for the Peruvian mines, was the period when his constructive genius flared forth with a brilliance which was almost continuous. To those years belonged his construction of the Camborne steam road carriage of 1801, his great patent of 1802 for stationary and locomotive high-pressure engines, his London steam road carriage of 1803, his historic rail locomotive, which he built at Penydarren in South Wales in 1804, his London rail locomotive of 1808, his application of steam engines to pumping, winding, dredging and agriculture, his invention of the Cornish boiler, his attempt to drive a tunnel beneath the Thames between Rotherhithe and Limehouse, and his patents for iron ships, iron docks and iron tanks. During the years 1797–1816 he was, in Prof. Inglis's words, "a veritable volcano of inventions". Some of these, because they ante-dated engineering progress by many years, failed to come to fruition, but others, notably the high-pressure semi-portable steam engine, gave an impetus to mechanical science which gathered momentum with the passage of time, and for which his successors mainly reaped the honour and financial reward.

One of Trevithick's inventions of this time was the water-pressure pumping engine, and speaking of a large engine of this type erected in Derbyshire, Prof. Inglis remarked: "This simple and powerful type of engine was verily the mechanical embodiment of its creator's mental and physical characteristics, and Trevithick's creations invariably inherited his own personal attributes—strength and exuberance of energy almost amounting to rashness." In comparison with Trevithick, Watt was a timorous spirit; steam in his mental vision was merely an agent for forming a vacuum, and the potentialities of danger he envisaged from the use of high-pressure steam outweighed any possible advantages which could be gained thereby. Trevithick, on the other hand, never counted that particular cost; he never permitted potentialities of danger to obscure his horizon, and it was this entire absence of fear which, perhaps more than any other mental characteristic, impelled him forward to win imperishable renown as the originator of the high-pressure engine.

Prof. Inglis's study was naturally based on the record of Trevithick as given in the biography published by his son Francis in 1872, and unfortunately he was not able to throw much new light on the actual construction of the engines through which Trevithick is known as the 'father of the locomotive', but his lecture contained many notable passages concerning the man himself.

The actual centenary celebrations began on Saturday afternoon, April 22, at Camborne by a demonstration. This was followed on Sunday forenoon by memorial services in Tregajorran Methodist Chapel, which stands on the site of Trevithick's birthplace, and in Dartford Parish Church, in which is a bronze tablet recording Trevithick's burial in the churchyard of St. Edmund, King and Martyr. Reference was also made to the centenary at evensong in Westminster Abbey by the Archdeacon of Westminster, the Ven. V. F. Storr, and after this service, the Memorial Committee placed a wreath beneath the Trevithick memorial window in the north aisle.

The service at Dartford Parish Church was attended by many members of the Urban District Council, representatives of many local associations and engineering societies and by the staff and employees of Messrs. J. and E. Hall, Ltd., in whose works Trevithick's last days were spent. The service was conducted by the vicar, the Rev. E. Mitchell, the sermon was preached by the Right Rev. the Lord Bishop of Rochester, and after the service an address was given by Mr. L. St. L. Pendred and wreaths were placed on the memorial tablet.

In concluding an address of singular eloquence, Mr. Pendred said: "I could speak to you of Trevithick's inventions; of his locomotives, his steam boats, his pumps, his boilers, his tunnel under the Thames. But what would it avail? You may read of these things if you will. They are now of no account. The tide of invention has swept over them. Precious and dear to the memory, but all sunken; not reclaimable, not useful any more:

> 'Wedges of gold, great anchors, heaps of pearls,
> Inestimable stones, unvalued jewels,
> All scattered in the bottom of the sea.'

"No inventor will turn to them for inspiration. Dead things. Drowned things. Swept over by the vast flood of invention which broke all barriers soon after Trevithick had gone to rest, and still sweeps onwards. You may see them in the Museum now. Toys; antiques; quaint relics. Valueless things . . . And yet, not valueless if they bring back the gift of Wonder to an age that has ceased to be surprised at anything. And if we can only wonder, we shall pay the greatest tribute of our praise to Trevithick. We shall wonder how a man with so little knowledge, so few opportunities of learning, such poor means of achieving, yet wrought from his brain things that no one else could think of, could *make*. It is not enough to think, one must *do* too. There are always some who will rob every inventor of his honour by proving that others had thought of the same thing before him. Thinking is not enough; it is the men who hammer their thoughts into realities that matter to the world. That was the way of Trevithick, the Cornishman; that is why we honour his name to-day."

Obituary

PROF. J. MILLAR THOMSON, F.R.S.

JOHN MILLAR THOMSON was born in 1849 in the precincts of the old college of Glasgow, where his father, Prof. Allen Thomson, was professor of anatomy. John Millar Thomson's family has had a long connexion with the University of Glasgow, dating from 1761, at which time his great-grandfather, John Millar, was professor of law. Other members of the family afterwards held chairs in mathematics, philosophy, medicine and anatomy, pathology and military surgery in one or other of the Scottish universities.

John Millar Thomson was an only child and was brought up in very close companionship with his father, with the result that he was from early boyhood constantly in contact with notable people in academic circles, especially as his father was one of fourteen professors all living in the old college. As a boy of thirteen years of age he travelled with his father in France and Germany, visiting a number of his father's friends. They remained for some time in Würzburg with Allen Thomson's great friend, Kölliker.

During the time when Prof. Allen Thomson was going into the plans of laboratories and lecture-rooms in the new University buildings at Glasgow, John Millar Thomson accompanied his father on several occasions where, as a boy, he could be helpful in such simple ways as 'holding the tape' and in taking down notes. This started an interest in architectural matters which he retained all his life. In discussing laboratories with him when he was at King's College, I have lively recollections of his sitting down to make plans, and of his saying, as he brought his scales and ivory rule out of his pocket, "These are the very ones with which my old father drew out his plans when I was a boy". His skill as an architect was such that when he drew out plans for a house for one of his cousins, these were accepted by the builders as complete, and were worked to by them.

Educated at the High School and the University of Glasgow, Millar Thomson entered the faculty of medicine after having first taken the usual curriculum in arts. He soon came to the conclusion, however, that he did not wish to continue a medical training. On the advice of Prof. Thomas Anderson and Prof. Lyon Playfair, he took up the study of chemistry. Naturally, from his early associations with so many professors, his ambition was to enter academic life. He worked as a student in Prof. Anderson's laboratory from 1866 until 1871, being appointed assistant to Prof. Anderson in 1869. In 1868 he came to London to see Prof. W. A. Miller and Prof. C. L. Bloxam with regard to a demonstratorship in chemistry at King's College, London, vacant owing to the transference of his friend J. T. Bottomley to the Physical Department of King's College. I remember his telling me about that interview and saying that, after it, he came to the conclusion that he was too young for the post. He returned, therefore, to Glasgow until, on the death of Prof. Miller in 1870, Prof. Bloxam, who succeeded to the chair of chemistry in King's College, sent for him and offered him a position of assistant demonstrator, which he took up early in 1871. Walter N. Hartley at the same time was appointed senior demonstrator. At that time the assistant demonstrator did not lecture, but Hartley became seriously ill shortly after his appointment, and John Millar Thomson took over the whole of the senior demonstrator's work in both the day and evening-class departments. Bloxam told me, in later years, of the great success of John Millar Thomson's lectures and of his organisation of the practical classes given into his charge.

In 1879, Hartley was appointed professor at the College of Science, Dublin, and Millar Thomson became senior demonstrator in his place. I attended his lectures in that year, and I can recall now the ease with which they could be followed, the clearness of his exposition, and the wealth of experiment with which the lectures were illustrated. His lectures were always interesting and often experiments difficult to carry out were shown by him with brilliant success, but he never allowed applause in College lectures. One other thing I can recall very clearly, namely, there was no chance of being visibly inattentive; still less was there any opening for levity or other form of disturbance. This was a tribute not only to his power of holding an audience, but also to his personality: one felt that 'fooling' was quite out of place. But strict and dignified as he was in the work of the College, both then and throughout his career he gained, in addition to the high respect of his students, their lasting affection.

From 1880 until 1887, in addition to his work at King's College, Millar Thomson gave lectures in chemistry at Queen's College, Harley Street, and was given the title of professor of chemistry in that College. It was during this time, and before he took the responsibility of the headship of the Chemical Department at King's College, that he carried out his investigations in connexion with crystallisation and supersaturated solutions, and also on a number of other subjects, for example, the composition and properties of building stones, in continuation of some work which he had done under Prof. Anderson at Glasgow.

Although he was much occupied with his own teaching and experimental work, he was a man with such strong general sympathies that he could not avoid being pressed to take an active and guiding part in practically all the College functions and functions organised by the students' societies. The Dramatic Society in particular owed much to him. He possessed remarkable dramatic talents and was truly a fine actor. This did not appear in his lectures, either at the College or at the many public lectures which he gave; into these he threw all his earnestness. It did, however, give him a singular power of expressing the wishes and desires of others when welcoming a new colleague, bidding good-bye to a retiring colleague, or speaking at functions such as College dinners or public dinners. I always felt, when John Millar Thomson spoke on such occasions, that in virtue of his personality, his manner, and his simple but effective elocution, he set the tone of the whole function on a high level. It was typical of him to say the right thing whenever he was called upon to speak, even at a moment's notice.

I must not omit some reference to his activities in photography, in which he had a life-long interest; for some time in his earlier days he taught the principles and practice of photography to the engineering students of the College.

The individual character and ability which he had shown, and the influence which he had exerted in promoting the highest interests of the College in these earlier posts, were emphasised when Millar Thomson became head of the Chemical Department at King's College. It was natural, therefore, that when the post of vice-principal became vacant in 1905 on the resignation of Prof. W. Grylls Adams, it was the unanimous desire of his colleagues that John Millar Thomson should be invited to take over the additional duties of vice-principal. He accepted, and represented the College on many important occasions. I have often heard from those who were present on such occasions how impressed they were with the charm, power and highmindedness of the man.

In notices of him in other places, his public work in connexion with the Chemical Society, the Institute of Chemistry and the University of London, has been described. I have endeavoured here to give some impression of the man himself. My opportunities for knowing him intimately were many, for I saw a very great deal of him not only in College but also in his private life.

I should not like to conclude without recalling Mrs. John Millar Thomson, the youngest daughter of Dr. Charles Arthur Aikin, a grand-niece of Miss Lucy Aikin, and a grand-niece of Mr. Arthur Aikin (who was secretary of the Royal Society of Arts from 1817 until 1839): she was also a great grand-niece of Mrs. Barbauld. I have often heard John Millar Thomson say how much he owed to the sympathy and ability of his wife. I myself was frequently present in their home, and when we were discussing College matters or the subject of a lecture, he would often turn to her for criticism and suggestions connected with decisions which he had made, and always with benefit.

John Millar Thomson was a remarkable man, of great ability, earnestness of purpose, and commanding influence, combined with a fine sense of humour and a great power of sympathy. He would have been a smaller man if he had realised how great a personality he really was.

HERBERT JACKSON.

THE death is announced of Mr. Walter E. Roth, which took place on April 5 after an operation at Demerara. Mr. Roth was a brother of the late Mr. H. Ling Roth, curator of the Bankfield Museum, Halifax. For many years before proceeding to British Guiana, Mr. Roth was Protector of Aborigines, Queensland, Australia. He was the author of "Ethnological Studies among the North-West Central Queensland Aborigines" (1897) and of a number of monographs on various aspects of the culture of the Queensland aborigines which appeared as official bulletins. He also wrote a number of papers, mostly technological, on the culture of the Indians of British Guiana which appeared in the *Journal of the Royal Anthropological Institute*, the reports of the Bureau of American Ethnology and elsewhere.

News and Views

Jews in Germany

THE political significance of Nazi revolutionary supremacy under Herr Hitler in Germany is outside our field; but the treatment of the Jewish learned and professional classes stands condemned in the eyes of the intellectual world. It is a relapse to the crass repression of the Germany of Heine's day and the *Judenhetze* of Prussia fifty years ago. An outstanding case is the resignation by Prof. James Franck, Nobel prizeman with G. Hertz for physics in 1925, of his chair in experimental physics in the University of Göttingen. Prof. Franck, it is said, probably would have been spared the forced retirement now operative against Jewish officials, including university professors; but he feels that Germans of Jewish descent are being treated as foreigners and foes of the Fatherland, and asks to be released from his office. Prof. Franck served with distinction during the War and received the Iron Cross of the First Class. His action follows fittingly on the retirement of Prof. A. Einstein from Germany, and is the logical, indeed the only, reply for a man of his standing to the acts by which Jews are being excluded from the liberal professions and debarred from the universities. This is the achievement of a movement which, ever since the War, has sought to mould the German people to one pan-Teutonic pattern—in accord with neither the facts nor the conclusions of ethnology. In the denial of a part in Germanic culture to any element alleged to be foreign, Jews, liberals and socialists are to be treated alike; but Jews have suffered most.

THE Jewish people need no one to hold a brief on their behalf. The contribution of the Jews to the growth of civilisation in the Western world speaks for itself. There were Jews in Germany in Roman times, and wherever they were found in medieval Europe, in spite of, or perhaps because of, their disabilities, they were laying the foundations upon which the modern system of finance and commerce was built up. In Italy as bankers, they rivalled the great houses of Lombardy. In the liberal arts, the preservation of much of classical literature and philosophy was due to them. In the later Middle Ages they were largely responsible for the reputation of Spain as a centre of intellectual and scientific development. In the middle of the eighteenth century the revival of Jewish learning, which had Mendelssohn for its inspiration and leader, paved the way for the Jewish people to take its place in the intellectual life of the respective countries of their adoption as their disabilities were gradually removed, so that Bunsen could say that, in the German universities of his day, the greater number of the principal professors were Jews. Everywhere the Jews have won to preeminence in literature, in the arts, especially music, and the drama. Even if it were not admitted that the Jews had contributed to Germanic culture—a contention which could not be accepted without argument—in the world of learning and science it is to men such as Oppert, the classical scholar, Benfey, the Orientalist, and Heinrich Hertz, the physicist, to take three names only, selected almost at random, that she owes her international standing, just as much as to any of her sons of purest German stock.

William Morgan, F.R.S., 1750–1833

WILLIAM MORGAN, who died on May 2, 1833, was the son of a doctor at Bridgend and studied medicine in London, but he failed to make headway after his father's death. He returned to London, where his uncle, Richard Price, found him work with the first life assurance company to grant assurances for the whole of life at a level premium depending on the age when the assurance was effected. This new venture gave Morgan his opportunity. He studied mathematics, applied them to life contingencies and produced, in 1779, his "Doctrine of Annuities and Assurances". He followed this with a series of five papers to the Royal Society in which, for the first time, solutions were given of complicated survivorship probabilities in terms that enabled a computer to use actual mortality statistics instead of an arbitrary law of mortality such as de Moivre's. He was given the Copley Medal in 1789 and his fellowship of the Royal Society in the following year. Morgan did still more important scientific work in connexion with his business, where he worked out the proper reserves that should be kept by a life assurance company and studied the difficult problems of surplus and bonus distribution so skilfully that he evolved a fair method for the particular scale of premium—the general problem still gives difficulty and is widely discussed even now. Morgan also studied the mortality experience of the persons insured, and his manuscript volume on the subject, from which he gave abridged tables in his published work, was the first investigation of the kind. Morgan published some tracts on public finance, wrote a life of Price and edited his works, contributed articles to Rees' "Cyclopedia", etc., and, in earlier days, displayed an interest in electricity and heat. His great achievement was that, in effect, he started the profession of 'actuary' and a new science which would nowadays be called actuarial science, and he proved that life assurance was a practical possibility and not merely an interesting theory.

Dr. William Babington, F.R.S., *1756–1833*

ON April 30 occurs the centenary of the death of Dr. William Babington, one of the founders of the Geological Society of London, who during his life gained the respect and admiration of all with whom he had come in contact, both by his skill as a physician and by the elevation of his character. Born in Ireland in 1756, at the age of twenty-one he became an assistant surgeon at the Haslar Naval Hospital, and four years later was appointed apothecary to Guy's Hospital, London, of which for some years he was also the physician. Though he made no notable contribution to science, he wrote several acceptable works on chemistry and mineralogy and it was at his house that in 1807 the gathering took place which led to the formation of the Geological Society, the first president of which was that "staunch geological Tory" George Bellas Greenough. Babington himself served as president in 1822 of the Society he had assisted to found. He was also one of the founders of the Hunterian Society. Described by Geikie as "a kindly, bland and courteous veteran", one of his last public actions before he fell a victim to an epidemic of influenza was to preside over the Priestley centenary celebrations. It was said that history does not recall a physician more loved and respected than Babington, and it was this wide-spread admiration for his character which led to the erection of his statue in St. Paul's Cathedral. The statue is a noble piece of work by Behnes. At his death, Babington was buried in St. Mary Aldermanbury in the City. He left several children and one of his daughters became the wife of Dr. Richard Bright, the discoverer of 'Bright's disease'.

Eradication of Prickly Pear in Australia

STRIKING success continues to attend the efforts to eradicate prickly pear (*Opuntia* spp.) in Queensland and northern New South Wales, mainly through the introduction of *Cactoblastis cactorum*. By the end of 1930, some 3,000,000,000 eggs had been distributed throughout the length and breadth of the sixty million acres infested and by the end of 1931 the insect existed on practically every acre. To-day probably 80 per cent of the dense primary pear in Queensland has been destroyed, while in New South Wales the figure is 50–60 per cent if one excludes the Hunter Valley and Camden districts where climatic and soil factors are delaying, but not preventing, the progress of *Cactoblastis*. Queensland is energetically pushing a scheme of development of reclaimed land and already 1,515,000 acres have been re-selected for mixed farming purposes and 1,701,000 for grazing. Unfortunately, the sight of miles of dead and rotting cactus tends to create the impression in political circles that the problem is solved and that further expenditure upon intensive research work is not needed.

SUCH views are dangerous and quite unjustified. Re-growth, owing to incomplete destruction of butts and roots, is a problem which grows in seriousness as the old pear, supporting an insect population ready to attack new shoots, disappears. It will be unwise to leave the control of re-growth to *Cactoblastis* alone. Also parasitism, though not yet causing more than 20 per cent loss in any district, and much less in some, requires close watching: and the Hunter Valley area of two to three million acres presents a unique problem in some respects, though *Cactoblastis* is more promising there to-day than it was eighteen months ago. Moreover, though the infestation is almost entirely the vulnerable *O. inermis* and *O. stricta*, it would be unwise to ignore the menace of the tiger-pear (*O. aurautiaca*) now covering some 25,000 acres, and the tree pears (*O. tomentosa* and *O. streptacantha*). *Cactoblastis* destroys the upper growth but not the underground bulb of the former, the recuperative powers of which are very great; while it destroys only the young plants of *O. tomentosa*. Other enemies of these must be sought and entomologists have already been sent to South America to seek parasites of them and allied species.

A Complex Solar Halo

A VERY well-developed solar halo of 22° radius with mock sun ring was observed from places in Kent and Sussex on April 14. An excellent description has been received from Mr. R. C. T. Evans and his son, Dr. C. Evans, 10 Eddington Lane, Herne Bay. The 22° halo was observed at about 12.35 p.m. (B.S.T.), and two "bright patches" proceeding not quite radially from the eastern and western sides, at angular positions corresponding roughly with those of the hour hand of a watch at 9.30 and 2.30 o'clock. Shortly afterwards, these bright patches were observed to form part of a luminous ring which reached northwards to about the position of the pole star (invisible, of course, at the time) but did not cross the region inside the 22° halo. The elevation of the sun must have been nearly 48° at this time and that of the pole star only very slightly greater in this latitude; there seems, therefore, every reason for believing that this ring, which was faint except near the 22° halo, was the mock sun ring, which has the zenith for its centre. The 22° halo showed strong red coloration on the edge nearest to the sun, and a suspicion of blue towards the outside—usual features when this halo is strongly developed. There are two points of particular interest about this display. The haloes were seen from near the centre of a large anticyclone, whereas well-developed haloes are more often seen near the outer margin of a depression or even well within the cyclonic vortex. Further, the description from Herne Bay states that the bright patches near the 22° halo, which formed part of the mock sun ring, showed some red colour at the ends nearest to the sun, which is unusual, and they appeared to lie between the observer and one of several flocculent clouds present in the sky which passed across the eastern bright patch. Optical theory suggests that all parts of the haloes were due to a much more elevated veil of cirriform cloud which, on this occasion, was only dense enough to make the blue of the sky appear pale, and that the flocculent clouds should have lain in front of the haloes.

New Ascent into Stratosphere

Soviet men of science are planning an ascent into the stratosphere in July. The ascent will be made in a balloon which is being specially built for the purpose under the supervision of the Leningrad Section of Osoaviakhim (Society for Air and Chemical Defence). Attached to the balloon will be a large, hermetically sealed gondola in which the investigators will be seated. They will wear special clothing and will be equipped with parachutes in case a forced landing is necessary. A meeting of the committee which is arranging the flight has recently been held in Leningrad. It is proposed to make the ascent from the central part of European Russia. The exact point has not yet been decided upon. A trial 12 km. flight into the stratosphere will first be made in order to accustom the investigators to the experimental conditions. The engineer in charge of construction of the balloon, Mr. Chertovsky, and Mr. Vasenko, its designer, are to make the trial flight. In July it is planned to penetrate to a height of 22 km. Among those making the ascent will be Prof. Rynin, a well-known authority on aeronautics, and, health permitting, M. Joffe, an eminent Soviet physicist and member of the Soviet Academy of Sciences.

The Great Siberian Meteorite

A special meteorite commission has been appointed by the Soviet Academy of Sciences to investigate the traces of the large meteorite which fell in the Enisseisk district of Siberia on June 30, 1908. The commission is making preparations to set out on an expedition to the Tungus swamps some time this summer under the leadership of the Soviet meteorologist, Mr. Leonid Kulik. This is the fourth expedition that has been led by Mr. Kulik to search for traces of the Tungus meteorite. The expedition sent out in 1927 discovered in the place where the meteorite fell uprooted trees over a radius of scores of kilometres, their tops towards the centre. Trees blown down by the wind were lying over an area of fifty kilometres from the falling place of the meteor, and the whole locality over a radius of twenty kilometres from the centre was scorched by the high temperature produced. The expedition of 1929 carefully examined the northern section of the central area of the wind-felled wood and made some excavations in the centre. The exploration of the southern part of this wood confirmed the belief that the meteorite had fallen in that spot. The first three expeditions led to the discovery of immense areas of wind-felled trees and traces of burning, but no specimens of the meteorite were found. The aim of the new expedition is to find the exact place of the submerged crater and if possible to obtain specimens of the meteorite itself. In April 1930 Dr. F. J. W. Whipple read a paper on the meteorite and its effects before the Royal Meteorological Society under the title "The Great Siberian Meteor and the Waves, Seismic and Aerial, which it Produced" (*Quar. J. Met. Soc.*, vol. 56, July 1930).

Research and the Linen Industry

In presenting the report at the thirteenth annual general meeting of the Linen Research Association on December 12, 1932, Mr. H. L. McCready, chairman of Council, referred to the importance of research in promoting the welfare of the linen trade and the restoration of prosperity. Due mainly to a reduction of £1,000 in each of the grants from the Empire Marketing Board for flax and fibre production work and from the Department of Scientific and Industrial Research, there was an excess of £2,837 of expenditure over income, £1,444 of this being represented by reserves for rent and depreciation. In spite of drastic economy, however, it was possible to develop during the year what appears to be a much improved and more economical method of treating flax. An entirely new system of handling the material was evolved, existing machinery was improved, new machines designed and constructed, and a superior article of good colour, straight, parallel and clean was produced. Useful work was carried out on various aspects of the bleaching and dyeing of both yarn and cloth. A good deal was discovered about the effect of various reagents on the strength of the fibre. The increased use of coloured effects for borders and checks caused attention to be given to the dyes used and information of the utmost importance regarding various dyes was obtained. The director of research, Dr. W. H. Gibson, underlined the emphasis which Mr. McCready laid on the service aspects of research. There has been a strong tendency for the research work at every stage of the industry to be influenced by questions relating to the raw material on one hand or the requirements of the consumer on the other. The research worker has to take a comprehensive rather than a sectional view of the industry, and research is increasingly demonstrating its ability to give the consumer better service and better value, particularly in relation to the durability of fabrics in washing.

Essential News

For those persons who are interested in the world situation but have not the time or the opportunity to gather the necessary information and facts for themselves, *Essential News*, which is a weekly non-party bulletin, should serve a useful purpose. It is composed of quotations from various papers or periodicals and summaries of significant facts, together with constructive suggestions drawn from English and foreign sources. Thus, in a recent number special attention is devoted to economic reconstruction in Europe. There is a description of Delaisi's Five Year Plan for Europe, which advocates the planning of large schemes of work to reduce unemployment in Europe. The plan envisages the construction of great roads running north and south connecting the Baltic, Poland, the Danubian countries and the Mediterranean. This would open up an immense area in which some sixty million peasants are still living a primitive economic life. Another article in the same issue also bears on the construction of international roads; this is an extract from a pamphlet by Mr. J. E. Meade entitled "Public Works in their International Aspect". According to Mr. Meade, roads are cheaper to build than railways. The nineteenth century provided capital for railways; could not, he asks, the twentieth provide it for special motor roads? A European network of roads, roughly 9,000 miles in extent, financed by a European petrol tax of approximately one penny per gallon, built over a period of five years, would provide work for 188,000 workers in the first year, rising to three quarters of a million in the fifth year. The cost would be about 170 million pounds (gold). Some such roads already exist, in particular between Cologne and Bonn, between Milan and Turin, Como and Brescia, and one is being built between Rome and Naples.

George Edwards's Picture of the Dodo

THE biographical notice of George Edwards, the eighteenth century naturalist, which appeared in the January issue of *Science Progress*, may be amplified by some points of interest in regard to Edwards's picture of the dodo (*Didus ineptus*). Edwards, himself, tells us in the "Gleanings of Natural History", Part 2, 1760, that the coloured figure of the bird (Plate 294), was copied in 1757, as reduced, from a picture in oil-colours, of its natural size, this about thirty inches high. Further, that the original was drawn in Holland from the living bird from St. Maurice's Island (Mauritius) in the East Indies; that it was the property of Sir Hans Sloane, at the time of his death, becoming afterwards Edwards's property. The owner deposited (1759) the picture in the British Museum "as a great curiosity", and with Sloane's record. The original canvas, it may be mentioned, portrayed various other birds; also a few lizards and a toad. Edwards, however, simply selected the dodo for his plate, adding a guinea-pig for the sake of relative magnitude. It appears that the picture was copied in brighter colours (it was blackened through age) about 1877 by Mrs. L. Gunther, mother of Dr. Albert Günther, keeper of the Zoological Department of the British Museum. From this copy, which is at Oxford, a postcard in colour was ultimately made, and is obtainable at the Old Ashmolean, Oxford. The large picture which hangs in the Bird Gallery of the Natural History Museum, South Kensington, is the original canvas, which has been cleaned; the postcards in colour available at the Museum are reproductions of this picture.

Physical Bibliographies

THE recent issue of the index numbers of the physics and the electrical engineering volumes of *Science Abstracts* completes these volumes for the year 1932. The physics volume deals with 5,364 abstracts in 1,316 pages and the electrical engineering one with 2,926 in 756 pages. While the latter is slightly larger than the 1931 volume and author and subject indexes are on the same lines as in previous years, the former is about twenty per cent larger and its subject index has been greatly improved and its length increased about twenty-eight per cent to 197 pages. Physics papers are divided into eight main classes, each class into sections, with key-headings, and each section into sub-groups with sub-headings. For example, a main class—general physics—has twenty-one key-headings, one of which is elasticity and plasticity. This has ten sub-headings, two of which are photoelasticity and vibrations, with cross references to acoustics, piezoelectricity, seismology and thermodynamics. The key-headings are arranged in alphabetical order throughout the index. These improvements will be welcomed by users of the volume. The *Revue Bibliographique* of the *Journal de Physique* for 1932 is not yet completed but the volume for 1931 devoted approximately 130 pages to the subject index, 160 to author index and 850 to abstracts. In the subject index the whole of the sections under a class appear together and are divided into sub-sections or groups.

Veterinary Publications

WITH the January number (vol. 3, No. 1) the *Veterinary Bulletin* enters upon the third annual volume. A regular monthly issue, begun with vol. 2, will be continued, and by some adjustment of the lay-out of the pages more space will be available for a larger number of abstracts. In this first number, a list is given of the publications from which abstracts will be selected. The *Veterinary Bulletin* is published by the Imperial Bureau of Animal Health, Veterinary Laboratory, Ministry of Agriculture and Fisheries, Weybridge, Surrey, the annual subscription being £2. The Imperial Bureau of Animal Health also proposes to issue, should adequate support be forthcoming, under the title *Index Veterinarius*, a complete index to publications relating to veterinary research, administration, etc. An annual volume in crown quarto size would run to about 1,600 pages and a number, consisting of about 400 pages, would be issued each quarter. The *Index* would be prepared on a Gestetner duplicator: the sheets printed on one side only, clear to read, and adequately glued, stitched, and bound. About 10,000 references would be indexed each year, with cross-indexing. The price would be £4 the annual volume, including postage.

Horticultural Education Association Year Book

It is with great pleasure that we notice the appearance of a Year Book of the Horticultural Education Association for 1932 (South-Eastern Agricultural College, Wye. 3*s*. 6*d*. post free). This volume, which we hope is the first of a long series, contains many items of importance to members of the Association, but also has several articles of general horticultural importance. Horticultural activities in various counties are described by the respective county agents or supervisors. Other articles refer to spray spreaders, vegetable breeding, glasshouse research, vegetable diseases, insecticides and fruit storage problems. The Association and particularly the editor, Mr. R. T. Pearl, are to be congratulated upon the production of a very useful volume at a reasonable price.

Marmite

We have received from the Marmite Food Extract Co., Ltd., London, E.C.3, a booklet describing the medicinal and dietetic value of 'Marmite'. This is an extract of yeast, rich in vitamins B_1 and B_2. Vitamin B helps maintain the appetite and proper function of the digestive tract, and also aids growth, reproduction, and lactation. The reserves in the body are very small, so that a regular daily intake is required. Recent work has shown that 'Marmite' is of value in the treatment of the pernicious anæmia of pregnancy, in the anæmia of sprue and cœliac disease and possibly also in true Addisonian pernicious anæmia: all these anæmias belong to the megalocytic group. Strauss and Castle believe that normal hæmatopoiesis depends upon the interaction of two factors, an intrinsic one present in normal gastric juice, and an extrinsic one occurring in certain foodstuffs, which is abundant in 'Marmite' and may be identical with vitamin B_2. Up to 4 ounces of 'Marmite' may be taken daily by an adult.

Dorothy Temple Cross Research Fellowships in Tuberculosis

The Dorothy Temple Cross research fellowships in tuberculosis for the academic year 1933–1934 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than June 1. The object of these fellowships is to give special opportunities for study and research to persons "intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms". Candidates must be British subjects and must possess suitable medical, veterinary or scientific qualifications. The fellowships will preferably be awarded for projected studies or inquiries outside Great Britain. They will be awarded for one year as a rule, and are of the annual value of not less than £350. It may also be possible to award a senior fellowship of considerably greater value for an intensive study of some particular problem of tuberculosis at a chosen centre in another country. Further particulars are obtainable from the Secretary, Medical Research Council, 38, Old Queen Street, Westminster, S.W.1.

Announcements

The Daniel-Pidgeon fund for 1933 of the Geological Society of London has been awarded to Mr. J. D. Solomon, who proposes to undertake the correlation of the Pleistocene deposits of south-eastern England with those of neighbouring parts of the Continent.

Senatore Prince Ginori Conti will read a paper on "The Natural Springs of Tuscany and their Industrial Application" before the Royal Society of Arts, Adelphi, London, on May 3, at 8 p.m. The historical development of the venture and its condition at the present day will be described, and illustrated by a film. The natural steam power developments, with special reference to boracic acid production, at Larderello, Tuscany, were described in an article in Nature of January 14, 1928.

The annual meeting of the members of the Royal Institution for the election of officers and to receive the annual report of the Visitors for the year 1932, will be held on May 1. At the conclusion of the annual meeting a portrait of Sir William Bragg, painted by Mr. William Nicholson, will be presented to the Royal Institution.

The Ministry of Health has issued revised port sanitary regulations (Statutory Rules and Orders, 1933, No. 38) which will come into operation on May 1, together with an explanatory circular (1296). These regulations will replace several regulations of 1907, 1920, and 1929. The aim is to consolidate most of the regulations relating to the control of shipping in ports, and to bring quarantine procedure into line with modern methods of international interchange of information relating to epidemic diseases.

Applications are invited for the following appointments, on or before the dates mentioned:—An assistant borough electrical engineer for the Fulham Borough Council—The Town Clerk, Town Hall, Fulham, S.W.6 (May 8). A professor of mathematics and natural philosophy at the McCrea Magee College, Londonderry—The Secretary of the Faculty (May 10). A headmaster of the Ashton-under-Lyne Junior Technical School—G. W. Handforth, Education Office, 8, Warrington Street, Ashton-under-Lyne (May 13). An independent lecturer in mathematical physics at the Queen's University of Belfast—The Secretary (June 12). A woman teacher of science, agricultural science, gardening, geography, and hygiene at the Shortwood Training College for Women Elementary Teachers, Constant Spring, P.O., Jamaica—The Secretary, Cross Roads P.O., Jamaica. A mechanical draughtsman for the Sudan Railways—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1. Mechanical engineers in the Royal Army Ordnance Corps—The Under-Secretary of State (A.G.9), The War Office, S.W.1.

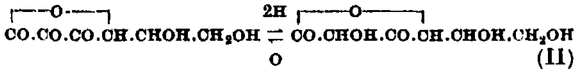
Erratum. In Nature of April 22, p. 565, col. 2, lines 15 and 16, for phrase "one asymmetric carbon atom" read "no asymmetric carbon atom".

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

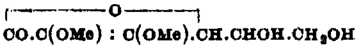
Constitution of Ascorbic Acid

WE have now confirmed the accuracy of the structure (I) $\mathrm{COOH.CO.CO.CHOH.CHOH.CH_2OH}$ which we had previously assigned to the first (reversible) oxidation product of ascorbic acid on the ground that it yields oxalic acid and trihydroxybutyric acid (*l*-threonic acid) on further oxidation[1]. The above formulation represents an open chain acid, but it is now evident that at the moment of formation the substance behaves as a lactone of (I) and not as the free acid. We have already advanced a constitutional formula for ascorbic acid (represented by (II) and its tautomerides) which shows the relationship between (I) and (II) to be as follows :[2]



$$\mathrm{CO.CO.CO.CH.CHOH.CH_2OH} \underset{\mathrm{O}}{\overset{\mathrm{2H}}{\rightleftharpoons}} \mathrm{CO.CHOH.CO.CH.CHOH.CH_2OH} \qquad \text{(II)}$$

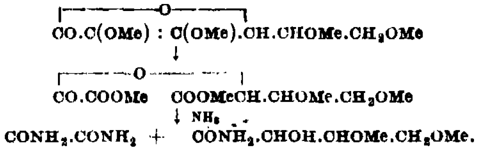
Strong evidence in favour of these views has been obtained from a study of the properties of the methylated derivatives of ascorbic acid. We find that dimethyl ascorbic acid (III), obtained by the action of diazomethane on ascorbic acid, is a neutral substance which reacts with one equivalent of warm $N/10$ alkali without elimination of methyl alcohol. The formation of the sodium salt appears to involve the opening up of the lactone ring in (III). Both methoxy groups are therefore enolic in character (contrast Karrer[3] and Micheel and Kraft[4]). Profound decomposition occurs when the dimethyl derivative is warmed with strong alkali. In this respect the tetramethyl derivative (see below) is much less stable and on continued heating with $N/10$ alkali it breaks down with elimination of at least three molecules of methyl alcohol.



$$\mathrm{CO.C(OMe):C(OMe).CH.CHOH.CH_2OH} \qquad \text{(III)}$$

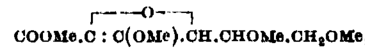
The crystalline substance, m.p. 123°, obtained by Micheel and Kraft[5] by the action of methyl alcoholic ammonia on dimethyl ascorbic acid is apparently formed in an analogous manner by the addition of ammonia to the lactone group of (III). The two methoxyl groups of dimethyl ascorbic acid are retained in the product, which we find behaves as an amide. It contains one molecule of combined methyl alcohol and has an empirical formula $C_9H_{19}O_7N$ (not $C_8H_{15}O_6N$).

The nature of the ring system (1 : 4) present in dimethyl ascorbic acid has been determined by the degradative oxidation of tetramethyl ascorbic acid, obtained by the action of methyl iodide and silver oxide on the dimethyl derivative. On treatment with ozone the tetramethyl derivative gives rise to a neutral substance (V) which reacts immediately with ammonia giving quantitatively oxamide and 2-hydroxy 3 : 4-dimethoxybutyramide. Detailed examination of the hydroxy dimethoxybutyric acid has revealed that it consists of two isomerides, the main portion (80 per cent) being 3 : 4-dimethyl-threonic acid, which we have characterised by its conversion into 2 : 3 : 4-trimethyl *l*-threonic acid (amide, m.p. 77°, $[\alpha]_D + 66°$ in water). The remainder was found to be 3 : 4-dimethyl *l*-erythronic acid (amide, m.p. 113°, $[\alpha]_D - 34°$ in water). The amides of both hydroxy acids gave sodium isocyanate on treatment with sodium hypochlorite (Weerman's reaction) and are therefore α-hydroxy derivatives. The isolation of the two epimeric acids suggests that at some stage during the series of reactions enolisation has occurred at C_4. The observation is of special interest in that any possibility of such a change taking place in the plant or animal or during the process of isolating ascorbic acid has great significance from the biological point of view.



$$\mathrm{CO.C(OMe):C(OMe).CH.CHOMe.CH_2OMe} \qquad \text{(IV)}$$
$$\downarrow$$
$$\mathrm{CO.COOMe\quad COOMeCH.CHOMe.CH_2OMe} \qquad \text{(V)}$$
$$\downarrow \mathrm{NH_3}$$
$$\mathrm{CONH_2.CONH_2} + \mathrm{CONH_2.CHOH.CHOMe.CH_2OMe.}$$

The present observations are incompatible with the furane carboxylic acid structure for ascorbic acid advocated by Micheel[4] (which we had previously rejected for crystallographic reasons) and with the formulæ recently suggested by Karrer[6]. The oxidation results demand for tetramethyl ascorbic acid either (IV) or the structure



$$\mathrm{COOMe.C:C(OMe).CH.CHOMe.CH_2OMe,}$$

but apart from its inherent improbability on account of the propylene oxide ring, the latter formula is unable to explain the non-acidic character of the newly-formed first oxidation product of ascorbic acid or the behaviour of the methylated derivatives towards alkali and towards ammonia. On the other hand, all the observations offer strong support to (IV) for tetramethyl ascorbic acid and to (II) and its various tautomeric modifications for free ascorbic acid.

We wish to thank Prof. A. Szent-Györgyi for his kindness in placing at our disposal the ascorbic acid used in this work.

E. L. HIRST.
E. G. V. PERCIVAL.
F. SMITH.

Chemistry Department,
University of Birmingham.
April 7.

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[1] NATURE, **130**, 888 ; 1932.
[2] *J.S.C.I. (Chemistry and Industry)*, **52**, 221 ; 1933.
[3] *Helv. Chim. Acta*, **16**, 181 ; 1933.
[4] NATURE, **131**, 274, Feb. 25, 1933.
[5] *Z. physiol. Chem.*, **215**, 222 ; 1933.
[6] *Helv. Chim. Acta*, **16**, 302 ; 1933.

Vitamin B_4 and Adenine

IN a recent preliminary communication, R. Tschesche[1] has directed attention to the similarity between adenine hydrochloride and the crystals isolated by Barnes, O'Brien and Reader[2]. These crystals were specifically stated by them to have vitamin B_4 activity (10γ per diem per rat), but no claim was made that they were actually vitamin B_4. Tschesche does not state whether the specimen of crystals obtained by him was biologically active.

The general resemblance in many respects between the *isolated* crystals and adenine hydrochloride has been familiar knowledge in this laboratory for a considerable time. Before leaving the work in September, V. Reader tested a specimen of adenine hydrochloride (B.D.H.) for vitamin B_4 activity with negative results. In further work it has been found that some crystalline preparations of vitamin B_1[3] in which no adenine is detectable, are still contaminated with highly active vitamin B_4.

Hence, from two independent lines of evidence, vitamin B_4 and adenine cannot be identical. The published analysis of the crystals, though showing general agreement with the formula of adenine hydrochloride, left room for difference. Further unpublished investigations by R. D. Heard and J. R. O'Brien have shown that the crystals with vitamin B_4 activity consist, in fact, largely of adenine[4]. Therefore it now remains to separate and determine the nature of the active residue. The conclusion that vitamin B_4 itself must be active in doses of less than 1γ per diem seems to be irresistible.

It may be added that, so far, irradiated adenine has not exhibited vitamin B_4 activity in our hands.

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H. W. KINNERSLEY.
J. R. O'BRIEN.
R. A. PETERS.
V. READER.

Dept. of Biochemistry,
Oxford.
April 19.

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[1] Tschesche, *Ber.*, **66**, 581 ; 1933.

[2] Barnes, O'Brien and Reader, *Biochem. J.*, **26**, 2055 ; 1932.

[3] Kinnersley, O'Brien and Peters, *Biochem. J.*, **27**, 232 ; 1933.

[4] Details will be published when complete.

Absorption Spectrum of the Unsaponifiable Matter from Wheat-Germ Oil

In a recent letter to NATURE, Bowden and Moore[1] record data on the absorption spectrum of the vitamin E fraction of wheat-germ oil. So early as 1928, wheat-germ oil and extracts were studied here. The oil showed a maximum at 272 mμ ($E_{1\,\text{cm.}}^{1\,\text{per cent}}$ 1·9) and the unsaponifiable matter (kindly supplied by Prof. J. C. Drummond) gave evidence of maxima at 280 mμ and 256 mμ, together with weak selective absorption in the visible. On recrystallising, a white solid showing the ergosterol bands and very distinct maxima at 242 mμ and 253 mμ was obtained, whilst the more soluble coloured fraction still showed marked inflexions near 280 mμ and 256 mμ.

About the same time, a vitamin E concentrate from wheat-germ oil, made available by the kindness of Prof. H. M. Evans of California, was studied. The material was an orange solid (mainly sterol), the visible absorption of which suggested a carotenoid. The recrystallised sterol showed the four principal ergosterol bands with additional well-defined maxima at 242 mμ and 253 mμ, whilst the non-crystalline fraction exhibited an inflexion near 250 mμ.

Again last year, we examined an extract from wheat-germ oil kindly supplied by the Glaxo Research Laboratories. The alcoholic solutions showed the following bands :

λ max.	480	448	420	398	280 mμ (inflexion)
$E_{1\,\text{cm.}}^{1\,\text{per cent}}$	4·3	5·3	6	7	80

The material was worked up into a number of fractions without any very striking separation being achieved. The purified sterol contained small but appreciable quantities of ergosterol and an unidentified sterol showing maxima at 242·5 mμ and 252·5 mμ. An inflexion at 255 mμ appeared in some of the fractions from which sterols had been removed.

Early this year, another specimen of wheat-germ unsaponifiable matter was made available by the courtesy of British Drug Houses, Ltd. The maxima at 480, 448, 422 and 398 mμ again appeared in the crude material and in the residues obtained after recrystallisation. The sterol fraction contained ergosterol and the unidentified sterol in comparable amounts (less than 1 per cent of the gross non-saponifiable matter). The non-crystalline fractions exhibited several weak inflexions, notably at 300-310 mμ, 280-290 mμ and *c.* 250 mμ.

The observations of Bowden and Moore are thus confirmed. Further attempts at fractionation will involve high vacuum distillation of reasonably large quantities of material. Our data have not hitherto been published because no definite connexion between vitamin E and selective absorption has yet emerged.

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J. R. EDISBURY.

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University of Liverpool.
April 8.

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[1] NATURE, **131**, 512, April 8, 1933.

Fundamental State of Nuclear α-Particles

IT is known that γ-rays accompanying α-disintegration are due to the fact that an α-particle can escape from the nucleus with energy less than corresponds to the fundamental level, leaving the resultant nucleus in an excited state[1]. The relative intensities of these 'fine-structure' groups are given by the transparency of the potential barrier for corresponding energies $E(\alpha_n)$:

$$J(\alpha_n) = \exp\left[-\frac{4\pi e^2(Z-2)}{h\sqrt{[2mE(\alpha_n)]}} + \frac{8e\sqrt{m}}{h}\sqrt{Z-2}\,\sqrt{r_{\text{eff}}}\right]$$

$$\sqrt{r_{\text{eff}}} = \sqrt{r_0}\,\Big[1-0{\cdot}002j(j+1)\Big] \quad . \quad . \quad . \quad (1)$$

where j is the azimuthal quantum number of the escaping α-particle. These intensities must rapidly decrease with energy and will be still further reduced in cases when j is not zero in the excited states ; it can be calculated from (1) that this reduction will be respectively 1·3, 4, 16 and 105 times for $j = 1, 2, 3, 4$. Thus we come to the conclusion that, in cases where, for normal decay, the α-particle has $j = 0$, the slow groups of 'fine-structure' will be very weak.

I have shown[2], however, from the examination of irregularities in the change of nuclear radii in the different radioactive families, that for certain elements the normal group of α-particles has j differing from zero ; this seems to be the case for radium-actinium, actinium emanation and also, probably, for actinium C, radium C and thorium C. This means that the nuclei of the original and resultant element possess different spins, which is not so surprising if we remember that, for example, stable nuclei such as Bi^{209} and Tl^{205}, differing only by an α-particle, have spins differing by four units (9/2 and 1/2). For such cases the relative intensity of a normal group will be considerably reduced in favour of slower groups, for some of which the spin-difference between the original nucleus and the excited state of the resultant nucleus may vanish. For such α-transformations the 'fine-structure' will be much easier to detect, as the intensities of slower groups can be even larger than for the normal one.

If we turn now to the experimental evidence[3], we find that it is in radium-actinium, actinium emanation, and the three C-products mentioned above that relatively strong slow groups are present, while for other elements the intensities of these groups are practically on the limit of observation.

From the relative intensities of different 'fine-structure' groups of a given nucleus, it is possible also to determine the corresponding j's. For thorium C, for example, the calculated (for $j = 0$) and observed intensities of different α-groups are shown in the accompanying table :

Name of the group ..	α_1	α_0	α_2	α_4	α_3
Calculated intensity (for $j = 0$)	1·0	0·7	0·03	0·005	0·004
Observed intensity ..	0·3	1·0	0·03	0·002	0·02
Relative decrease ..	17	3·5	5·0	13	1

It may be concluded that for α_1 and α_4 we have $j = 3$, for α_0 and α_2, $j = 2$ and for α_3, $j = 0$ or 1. If we assume the spin-difference between the normal state of the thorium C and thorium C″ nuclei to be 3, we arrive at the following system of excited levels of thorium C″ : $\alpha_1(S)$; $\alpha_0(p)$; $\alpha_2(p)$; $\alpha_4(S)$; $\alpha_3(d$ or $f)$.

It is not possible at the moment to compare the energy levels for all nuclei for which 'fine-structure' is found, as the experimental evidence is not yet complete. The striking similarity between the levels of the nuclei of thorium C″ and actinium X is noteworthy : these two level systems differ from one another only by 40 per cent, which is evidently connected with the change of radius by 20 per cent ($6{\cdot}6 \times 10^{-13}$ and $7{\cdot}9 \times 10^{-13}$).

If we compare, however, the levels excited by α-decay with the level system of the radium C′ nucleus[4] excited by β-decay, we find at once that the energy differences are in the last case about four times larger, which supports the hypothesis that γ-radiation by β-decay is due to proton transitions[5].

G. GAMOW.

Physico-Mathematical Institute.
Academy of Sciences of U.S.S.R.,
Leningrad.
March 17.

[1] Gamow, NATURE, **126**, 397, Sept. 13, 1930.
[2] Gamow, NATURE, **129**, 470, March 26, 1932.
[3] Rosenblum, "Str. fine des rayons alpha". Paris, 1932.
[4] Gamow, NATURE, **131**, 433, March 25, 1933.
[5] Gamow, NATURE, **131**, 57, Jan. 14, 1933.

Periodicity in the Solarisation of Calcite

REPEATED solarisation due to a prolonged exposure to the light of a quartz mercury lamp was observed by the photoluminescence exhibited by calcite from Nabeto. A definite quantity (0·045 gm.) of the finely granulated specimen was put at suitable intervals of time into the depressions of the sample holder[1] placed 15 cm. underneath the lighted lamp (100 volts, 3·1 amp.) which was employed as a constant source of exciting light. Thus a set of samples was subjected to excitation. A panchromatic plate was then applied, immediately after cessation of excitation, on the sample holder, thus charged with a set of the samples excited for discrete durations of time, the distance between the surface of samples and the photographic plate being 3 mm. After being left two hours, the plate was developed, and the photographic densities of the images generated on the plate by the action of phosphorescent light of the excited samples were determined by means of a microphotometer. The results are shown graphically in Fig. 1, which gives the growth curve of photoluminescence, indicating its periodic reversal under the exciting rays. The ordinates represent the density corresponding to the intensity of phosphorescence and the abscissæ the duration of excitation.

As will be seen, the first maximum of the intensity of luminescence appears at about two hours irradiation. With a still longer irradiation, the luminescence gradually loses in intensity owing to the solarisation of the sample. If the excitation is continued further, a minimum of the intensity of luminescence is reached at about twenty-five hours exposure, and a gradual increase of intensity is then observed again up to the second maximum attained at about thirty-three hours irradiation, after which another reversal begins again. Of course, the intensity of photoluminescence corresponding to the second maximum is very weak as compared with that corresponding to the first maximum. The result is quite reproducible with new samples.

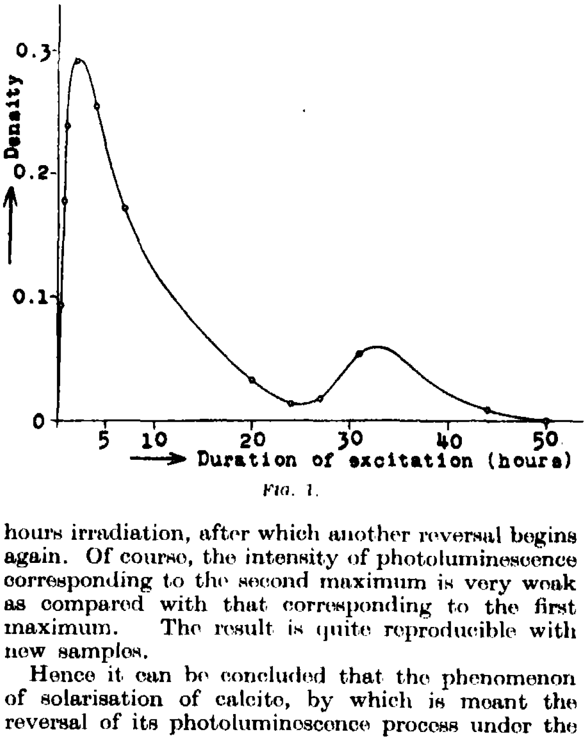

FIG. 1.

Hence it can be concluded that the phenomenon of solarisation of calcite, by which is meant the reversal of its photoluminescence process under the continual action of the light of quartz mercury lamp, is apparently analogous in character to the well-known photographic reversal.

S. IIMORI.

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Tokyo, Japan.
Feb. 2.

[1] S. Iimori and E. Iwase, *Sci. Pap. Instit. Phys. Chem. Res.*, **16**, 41 ; 1931.

Origin of Cosmic Radiation

EXPERIMENTS seem to show that the cosmic rays are very fast particles, coming from world space ; but at present there is no acceptable theory of the phenomena giving rise to them. Neither Millikan's nor Jeans's hypotheses of nuclear integration or annihilation processes, nor Regener's[1] or Swann's[2] theories, seem to be in accordance with the latest experimental results.

In world space we have a mixture of single atoms and larger particles (cosmic dust, meteors, etc.). Between the single atoms and the larger particles there can be interactions of two different kinds:

A. The single atom collides with the large particle. Then there will be an exchange of energy between the single atom and one of the atoms of the large particle. Processes of this kind will give the single atom a kinetic energy of about the same magnitude as the thermal equipartial energy of the large particle.

B. The single atom, however, can also react with the whole large particle, considered as a giant molecule. This will happen when the atom does not actually collide with, but only passes in the neighbourhood of, the large particle. The energy exchange is then due to the electrical forces. According to the gas kinetic laws, the most probable process is, that the particle with the lower kinetic energy will gain energy. Even if the large particle has a mass of only 10^{10} gram, and a velocity of some km./sec., its kinetic energy is very much higher than that of the single atom. Therefore the kinetic energy of the atom increases at practically every encounter with large particles; and it seems probable that in a sufficient long time the atom can gain even as large energies as the 10^9 or 10^{10} ev., observed in the cosmic rays.

If we suppose, as mean values, that at every encounter with large particles, there is a probability δ (δ is a small quantity) for an A-interaction (at which a fast particle loses energy) and a probability $1-\delta$ for a B-interaction, at which the atom gains an energy ϵ; then after p encounters of every atom, there is left $n(1-\delta)^p$ atoms of n initial atoms, and each of these has gained the energy $p\epsilon$ (as a mean). Consequently, if we plot the numbers of atoms against their energy, we obtain an exponential curve. This is in agreement with the experimental results of Kunze[3].

It seems possible, therefore, to explain the origin of the cosmic rays, introducing no new hypotheses, and only applying the kinetic gas theory to the conditions of world space.

Hannes Alfvén.

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University, Uppsala.
March 17.

[1] *Naturwiss.*, **19**, 460; 1931.
[2] *Phys. Rev.*, **43**, 217; 1933.
[3] *Z. Physik*, **80**, 559; 1933.

Cathode Ray Photography of Random Electrical Transients

The recent improvements in the design of cathode ray oscillographs have naturally led to an exploration of their use for the external photographic recording of recurrent electrical events and also those of a transient nature which occur at random intervals. In the case of recurrent phenomena, such photography of the cathode ray trace is easy, but for random transients a satisfactory method must ensure that no event is missed and that fruitless exposures are few.

In some experiments carried out last summer, in collaboration with Prof. E. V. Appleton at King's College, we were concerned with the delineation of the rapid changes occurring in the earth's electric field due to both near and distant lightning flashes. These changes caused the fluorescent spot to move horizontally and were recorded on film carried by a revolving drum. By this method a resolution of pulses separated by time intervals of 20 microseconds was obtained, but it was unsatisfactory since the transient had to be anticipated and only a brief exposure was possible owing to the fogging caused by the background illumination of the tube. Methods employing a single time stroke and an electron beam trap were devised to minimise the relative intensity of this compared with the trace, but even so, distinct limitations are imposed.

These difficulties have been overcome by using the special cathode ray oscillograph supplied by Messrs. A. C. Cossor, Ltd., which gives a long after-glow of the red fluorescent trace, together with a form of circuit which gives a faithful oscillographic trace of an event, the occurrence of which is beyond the control of the operator.

The same method may be used to record the changes due to sustained or periodic phenomena occurring during a single sweep of the time base, which therefore obviates the necessity for a synchronisation of the repeated time base to obtain the steady picture necessary for a 'snap' exposure. The transient wave form remains on the screen long enough to enable the camera shutter to be tripped by a thyratron arrangement actuated by a small fraction of the initial voltage. This produces no apparent distortion of the wave form. The correct brief exposure is thus made a short time after the event has finished and a second relay can be used to move the film on to the next position. A valve phase change device ensures that the shutter shall be tripped by both positive and negative initial pulses. The response of the shutter relay system occurring after the electrical event, can be made before any substantial decay of the red after-glow and therefore the exposure is made during high luminescence of the trace compared with the general background. To obtain high photographic sensitivity a camera lens having an aperture of $f/0 \cdot 99$ is used and advantage taken of the special properties of hypersensitive panchromatic film. Records have, however, been obtained on panchromatic film (H. and D. 400) using an ordinary photographic lens of aperture $f/6 \cdot 3$.

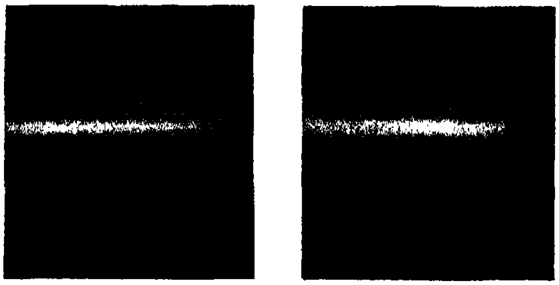
Fig. 1.

Fig. 1 shows two records, twice the size of the originals, of a condenser discharge through two different damping resistances, the exposure in each case being 1/25 sec. Records can be made on either a recurrent time base or 'tripped' single time stroke. In the case of the latter there is, however, the disadvantage that, with the present tube working at a gun voltage of 1500 volts, a stationary electron beam is accompanied by rapid disintegration of the luminescent material at the point of incidence of the beam.

These experiments have been carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

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Form and Vibrational Frequencies of the NO_2 Molecule

BAILEY and Cassie[1] have recently presented data on the absorption of $NO_2 - N_2O_4$ gas mixtures in the region from 2·5μ to 16μ, from which they conclude that the NO_2 molecule is linear and symmetrical. As their conclusions and in some respects their data are in disagreement with results obtained recently in this Laboratory, and earlier results[2], we wish to present briefly the facts that lead us to conclude that the atoms in the NO_2 molecule are disposed as an obtuse angle triangle. Detailed reports will be published elsewhere.

The most cogent argument against a linear model is the complexity of the fine structure of the discrete absorption bands in the visible and ultra-violet. The isolated band of NO_2 at 2491 A. clearly shows well-developed branches corresponding to rotations about two different axes of inertia, possible only if the molecule is non-linear in both the normal and excited states. We have examined the structure of the band under high resolution and find additional complexities associated with mutations about the third axis of inertia of magnitude indicating that the molecule is only slightly, but definitely, bent (apex half-angle > 55°) in the normal state. Weaker bands of practically identical structure occur at 751·1 and 1321·1 cm.$^{-1}$ on the long wave-length side of the 2491 A. band. Quantitative measurements of the temperature coefficient of absorption make certain that these frequency differences belong to the normal state, and are presumably the fundamentals ν_2 and ν_1.

In the infra-red we have made measurements with a prism spectrometer from 1μ to 4μ using deep layers of gas under controlled conditions and find a number of bands which we can definitely ascribe to NO_2 or N_2O_4. Those found in NO_2 and the bands found earlier above 4μ can be accounted for as combinations and overtones of fundamentals 751, 1321, and 1621 cm.$^{-1}$. The last fundamental corresponds to the strongest band found at 6·17μ by Warburg and Leithauser and checked by Bailey and Cassie. Frequencies equal to the sum of observed frequencies are found, again excluding the possibility of the linear structure. However, it should be stated that we can also account for all our infra-red bands by using the two frequencies suggested by Cassie and Bailey and assuming an inactive frequency of 1010 cm.$^{-1}$. The infra-red data available do not permit a unique answer as to the structure.

Although lacking details of their experiments, we think it possible to reconcile Cassie and Bailey's data with our model, as follows. The band found by them at 13·4μ is in good agreement with our ν_2 = 751 cm.$^{-1}$, the deformation frequency; that at 6·17μ is the ν_3 fundamental. The fundamental band corresponding to our ν_1 = 1321 cm.$^{-1}$, which should occur at 7·58μ, is missing. Inasmuch as the molecule is only slightly bent, we would expect this band to be the weakest fundamental; and it appears that the amount of gas in the absorbing layer was sufficient to bring out only the strongest bands, since they failed to report the strong 3·43μ band.

All the other bands, and possibly these also, may be ascribed to the N_2O_4 molecule, if the term molecule is not too definite to apply to what may be viewed as a more or less short-lived partnership of two NO_2 groups. In our infra-red work it is found that all the frequencies of NO_2 appear again in N_2O_4, indicating that the association bond is not strong enough to change appreciably the binding within the NO_2 groups. In addition, N_2O_4 has bands due to the extra degrees of vibrational freedom.

On our interpretation, calculation of the moment of inertia of NO_2 from the doublet separation of the 15·6μ band would have no significance; and such a calculation from the 6·17μ band must be regarded with caution, as a *Q* branch should be present. The intensity of the latter would however be small for a slightly bent molecule[3] and might well be missed except by spectrometers of the highest resolution.

Further measurements in the infra-red are necessary to settle the difficulties mentioned above. However, it seems that the moments of inertia of NO_2 will be obtained most accurately from an analysis of the electronic band spectra.

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W. S. BENEDICT.
G. W. KING.

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Mass. Institute of Technology,
Cambridge, Mass., U.S.A.
March 7.

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[1] NATURE, **131**, 239, Feb. 18, 1933.

[2] Warburg and Leithauser, *Ann. Physik*, **28**, 313; 1909. Daniels, *J. Amer. Chem. Soc.*, **47**, 2856; 1925. Harris, *Proc. Nat. Acad. Sci.*, **14**, 690; 1928. Herrmann, *Ann. Physik*, **15**, 89; 1932.

[3] Gerhard and Dennison, *Phys. Rev.*, **43**, 197; 1933.

Sporangia containing Spermatozoids in Ferns

ALTHOUGH ferns have in a few instances shown some irregularities in the development of the haploid and diploid generation, such as appertain to apogamy and apospory, there has so far been little concrete evidence to homologise the sexual organs (or their content) with sporangia (or their spores) in ferns. The fact that spermatozoids have now been found in normal sporangia of *Scolopendrium vulgare* may

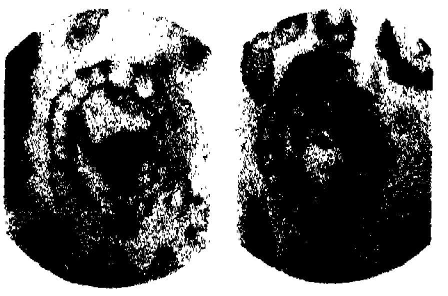
(*a*) (*b*)

FIG. 1. Sporangia with (*a*) spermatozoids, (*b*) spores. × 1350.

thus be of some interest from the phylogenetic point of view and may throw more light on the alternation of generations, which in ferns is of such a stable and characteristic type.

Only a small number of sporangia with spermatozoids have been found among the usual sporangia with spores. Both occur in the same sorus and are equally well developed as to stalk, wall, sequence of divisions, etc. The only difference is that about sixty (in one case possibly only thirty-two) spermatozoids develop instead of the sixty-four spores. In one instance, spermatozoids were almost certainly formed when the cells were still joined in tetrads.

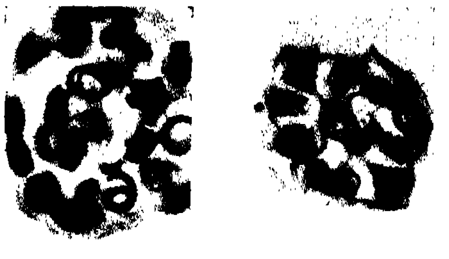
(*a*) (*b*)

FIG. 2. Photomicrographs of spermatozoids in (*a*) sporangium, (*b*) antheridium. × 4200.

These exceptional sporangia have now been observed in fixed material of four normal, fully fertile hybrids between the so-called 'peculiar' and the normal type of *Scolopendrium vulgare*[1]. It is probable that the phenomenon has something to do with the curious life-cycle of the 'peculiar' type.

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Merton.
March 3.

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[1] Andersson-Kottö, I., *Svensk Bot. Tidskr.*, **26**, Hft. 1-2; 1932.

Lunar Periodicity in Reproduction

IN view of the recent correspondence in NATURE[1] bearing on the question of reproductive periodicity in organisms, I should like to direct attention to some observations made by Miss S. M. Marshall and myself in Australia in 1928-29, which appear to indicate a type of such periodicity not previously recorded. In shallow pools on the Low Isles coral reef, one of the common corals is the branched species *Pocillopora bulbosa*. On some occasions, collections of branches of this coral will give off large numbers of planulæ; at other times, large collections of branches will give off no planulæ at all. During the period August 1928 to July 1929, about eighty collections of branches were made, representing hundreds of colonies. When the results of these collections were plotted, it was found that the production of planulæ was discontinuous, periods of production alternating with periods of no production. In the months December to April the productive periods occurred at about the time of *new moon*; in July and August at about the time of full moon; and in May and June a transition period was demonstrable from new moon to full.

I do not wish to emphasise this result too much, since the number of data is smaller than is desirable; but I am doubtful if it is possible to escape the conclusion that this coral breeds at Low Isles at about the time of new moon during part of the year, changing over to full moon for another part. There was a coincidence (but quite possibly no causal connexion) between this cycle and the behaviour of the tides, the lowest springs occurring during the winter months (May to October) at *new moon* and in *daytime*; during summer at *full moon* and *at night*.

If this interpretation of the records is correct, a change-over of the type described introduces yet *another complication into the already difficult* problem of finding any general explanation of the facts of lunar periodicity. A full account of the evidence here mentioned, together with information about the breeding of other corals and reef-animals, will be found in forthcoming reports of the Great Barrier Reef Expedition of 1928-29 (British Museum, Nat. History), vol. III, No. 8, and a subsequent report not as yet complete.

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[1] NATURE, **129**, pp. 344, 473, 543, 612, 655, 868, 906; 1932. **130**, pp. 23, 169, 243, 366; 1932.

"The Case against Einstein"

NOTHING is more difficult than with good grace to protest against an unfavourable review of one's work, but again nothing is more characteristic of mawkish sentiment than to refrain on that account from asserting a point of interest to science.

In "The Case Against Einstein" I dealt with a phase of scientific thought that has received immense publicity, and that, if valid, would give for all time its own direction to physical research and mathematical investigations. This theory I have criticised in a close and minute discussion of the crucial questions in the psychological, physical, and mathematical domains, and I have advanced arguments which, true or false, are there expressed in lucidity and in rigorous form. If my reasoning is false, I have done nothing at all; if true, I have demolished the whole system of relativity and removed an incubus from the minds of students of physics all over the world. Incidentally, I have also indicated new forms of analysis which, applying to all sciences, have a direct bearing on this subject.

To this aspect of the exposition the reviewer of my book in NATURE of February 25, p. 260, has paid no attention whatever; he has devoted the very short notice accorded the book to a complaint against the "emotional" style of my writing. The emotion, consisting mainly of laughter, was directed against the tendency which I believe to prevail, even in high scientific circles, of judging a work of science, not on its intrinsic value in regard to science, but by influences, moral or immoral, which have nothing to do with the scientific merit. The "emotional" part of my book was necessary to combat the enormous popular prestige that Einstein's doctrine has acquired, so as to enable me then to focus on the essential issues involved.

ARTHUR LYNCH.

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March 26.

Research Items

Great Bear Lake Indians. The Annual Report for 1931 of the National Museum of Canada contains an ethnographical study of the Great Bear Lake Indians of the Mackenzie District, North-West Territories, by Dr. Cornelius M. Osgood, undertaken for the Museum between May, 1928, and September, 1929. The Great Bear Lake is the focal centre of four tribes of the north-eastern Athapascans, well known in Canadian history as the Dogribs, Yellow Knives, Hares and Slaves, with the Satudene or Great Bear Lake Indians in the centre, who though politically, socially and linguistically distinct from the Hares to-day, may have become so only within the last hundred years. The tribal boundaries represent the extreme range of the tribes, but they occupy and hunt over a very small section only at any one time. Owing to climatic conditions, the food problem is insistent. It imposes a migratory habit, and at times under stress has led to cannibalism. When food is plentiful the Indians eat enormously, but no food is laid up against scarcity, as among the peoples of the Pacific coast. This in part is due to difficulty of transport, as they have to move from one place to another seasonally according to the habitat of their food supply, fishing in one place in winter, another in summer, visiting another to obtain skins for clothing and so forth. Individual effort to attain personal security, in view of the communistic habit of the tribes, is regarded as anti-social. The principal article of diet is fish, taken in winter by nets ingeniously spread under the ice. Next come moose and caribou. The moose is shot. The caribou was formerly taken by stalking, decoying, impounding, snaring and spearing. The hunting was a communal affair, initiated by the two most important men, the best hunter and the oldest man, the latter being assigned the meat for distribution. There is no individual ownership of hunting grounds. A variety of minor animals and birds was eaten. Franklin (1828) records the eating of a special kind of clay in times of scarcity or, as a chewing material, for amusement.

Archæology of the Marianas Islands. Miss Laura Maud Thompson has published a study (Bull. 100, Bernice P. Bishop Museum) of a collection of more than 9,000 archæological specimens and field notes made by Comdr. Joseph Thompson, and Mr. and Mrs. Hans Hornbostel in the Marianas, which is now in the Museum at Honolulu. The collection includes monuments, potsherds, stone implements, and skeletal remains as well as texts with translations, maps, photographs, etc., illustrative of the former culture of the Chamorro. The Marianas are of outstanding importance for the ethnology of Oceania, as they stand at the extreme north-west of the Micronesian culture area. No detailed account of this culture has previously appeared. Pure-blooded Chamorros became extinct at the end of the seventeenth century, when nearly all the males were exterminated in a religious war between natives and Spanish missionaries. Of the Chamorro culture only the language remains but slightly altered. One of the most striking features of the ancient culture is the stone monument. In Guam the stone monuments occur along the shores and in the well-watered lowlands of the interior. Double rows of upright stones are associated with caps and are accompanied by burials, potsherds, and stone and shell implements. One of the most extensively excavated sites is that of Epau, on the north-west coast. It consists of two straight parallel rows of roughly cut coral uprights, four in each row, placed in a rectangular plan with axis parallel to the shore. On the surface of the ground near each upright is a coral head-cap which apparently has fallen from its position on the upright. The uprights are about 11 ft. apart with a distance of 12 ft. between the rows. Large retaining stones support each upright. Here seventeen extended burials were found, head to south-east but facing south-west (left). They were of different ages and of both sexes. At head, chest and knees were scattered bones, potsherds, stone implements, shell scrapers and slingstones. Six skeletons had parts missing, in one instance the skull, and five showed marks of fire.

Jumping Rodents. A. B. Howell (*Proc. Amer. Acad. Arts and Sci.*, 67, No. 10; 1932) has undertaken a detailed anatomical examination of the kangaroo rat, *Dipodomys*, of the New World and of the jerboas of the Old World, with special reference to the structural modifications due to jumping and to the convergence exhibited by these two groups of rodents, which belong respectively to the families Heteromyidæ and Dipodidæ. An account of the habits precedes the anatomical description. In both groups there is some broadening of the face and a progressive weakening of the masticatory musculature, but the first of these changes is probably correlated with the enlargement of the tympanic bullæ. The neck, always short in rodents, has undergone further shortening and there appears to be also a shortening of the body with increased saltation and an increase in the strength and complexity of the back musculature associated with its use, in connexion with the hind limbs, in leaping. There is a decrease in the length and robustness of the arm and an increase in the length of the leg. The progressive elongation of the hind limb is especially marked in the pes, involving both metatarsals and digits. The breadth of the pes decreases and there is compaction of the bony elements resulting, in the most specialised forms, in fusion of the central metatarsals, and there is a tendency toward reduction and eventual elimination of the lateral digits. The perissodactyl type of foot is eventually attained, save that in the most highly specialised forms the third digit is more slender than the second and fourth, but in these cases the three middle digits tend to become grouped into a functional unit. The result of these specialisations is the assumption of a bipedal, saltatorial, digitigrade gait. The most specialised of the jerboas are far in advance of the kangaroo rats in saltatorial features. The most generalised of the Heteromyidæ are not discernibly fitted for leaping so that within this family saltatorial specialisation varies from little to much; the Dipodidæ are all highly specialised and would appear to have been exposed to saltatorial influences for a longer period of time.

Insects of the Marquesas Islands. Under the title "Marquesan Insects—I." (1932) the first of a series of bulletins dealing with collections made in the Marquesas and Society Islands has recently come to hand. It is issued by the Pacific Entomological Survey which is supported by grants from the Hawaiian Sugar Planters' Association, the Hawaiian Pineapple Canners' Association and by contributions from various sources made available by the Bernice P. Bishop Museum. The Marquesas Islands were selected for first consideration on account of the rapid floral changes known to be taking place in that group and its probable repercussion upon the fauna. Furthermore, the biology of this isolated archipelago seemed to afford valuable opportunity for zoogeographical study. Most of the collecting was done by Messrs. E. P. Mumford and A. W. Adamson and the specimens are being deposited, as worked out, in the Bishop Museum, Honolulu. Some twenty-seven papers are contained in the present part and are written by various authorities on the different groups of insects concerned. Special interest is attached to Dr. R. C. L. Perkins's descriptions of two species of weevil-like beetles of the genus *Proterhinus*, which is centred in Hawaii with but few forms known outside that group of islands. Among the termites, which were hitherto unknown from the Marquesas Islands, seven species are brought to notice, by Mr. S. F. Light, of which three are regarded as new. Dr. W. M. Wheeler writes on ants, a number of new Diptera are described by Mr. J. R. Malloch and, among other contributions, are two papers of Mr. G. F. Ferris on ectoparasites. The publication is issued by the Bernice P. Bishop Museum, Honolulu.

Periodicity in Tree Growth in the Tropics. An interesting contribution on this subject by Jean Schweizer, of Djember, Java, has appeared (*Mitt. Naturforsch. Ges. Bern*, 1932). As a result of the recent extensive vegetative propagation of *Hevea Brasiliensis*, it is now possible to compare the behaviour of clones, propagated from the same individual, under widely different conditions of cultivation and climate. The author has thus been convinced that individual differences as to time of leaf production, length of rest period, etc., are inherited characteristics although they may be modified by climate, altitude, manurial treatment, etc. He points out that the rest periods of seedlings of *Hevea* are comparatively short, and two or more crops of foliage may be developed in the year, but that the rest periods increase in length with the age of the individual, when the periodicity tends to be linked with the annual climatic cycle. An interesting observation was the effect of manurial treatment in temporarily obliterating the markedly individual behaviour shown by the different branches of the same tree as to the period of leaf production; an individuality which reappears in later years as the effect of the manure diminishes. The results of defoliation experiments are described and shown to depend upon the periodicity of growth processes at the apex. When the new crop of leaves is expanding, the growing point is forming new leaves and at this stage defoliation has little effect on the periodic cycle. Later, the growing points are forming flower buds and defoliation during this period may postpone the rest period.

Probable Meteorite Scars in Carolina. In 1930 some peculiar elliptical depressions occurring in South Carolina were photographed from the air. A careful study of the photographs showed that the origin of these 'bays', as they are called locally, presents problems of extraordinary interest. F. A. Melton and W. Schriever visited the region in the following year and their account of the observations made and conclusions reached is now published (*J. Geol.*, 52–66; 1933). The characteristic features and relationships of the depressions are (*a*) a smoothly elliptical shape; (*b*) parallel alignment in a south-eastern direction; (*c*) a peculiar rim of soil that is generally larger at the south-eastern end than elsewhere; and (*d*) mutual interference of outline. Consideration of all these and other related facts leads to the conclusion that the origin cannot be attributed to the operation of ordinary geological processes. A hypothesis involving impact by a cluster of meteorites is presented as affording the most reasonable explanation. The supposed swarm must have been large enough to possess a cross-sectional area of the order of 50,000 square miles at right angles to the direction of movement. Similar features are not known to exist elsewhere on the earth's surface. The depressions are, however, so inconspicuous to observers on the ground that even the topographic surveyors seem to have failed to see their significant characters. Aerial surveys in other coastal plains may therefore disclose the existence of similar scars that have hitherto been overlooked.

Geology of South Africa. At the meeting of the Geological Society of South Africa on November 14, 1932, Dr. S. H. Haughton recorded the results of the revised survey of the Cape Town–Stellenbosch area. The succession of the pre-Cape rocks is thus pictured: (1) Deposition of the Malmesbury sediments with local volcanic activity shown by amygdaloidal lavas, obsidians and agglomerates. (2) Accumulation of the French Hoek volcanics of the Simonsberg area, consisting of felsitic lavas and tuffs and some quartz-porphyries. (3) Formation of the French Hoek Beds: conglomerates, arkoses, grits and shales. (4) Folding and shearing of the above deposits. Intrusion of the granite, which mainly invaded the older Malmesbury beds, followed by quartz-porphyry sheets in the newer French Hoek beds. (5) Erosion, followed by the deposition of the Klipheuval sediments. (6) Movement and possible faulting of all the above. Some of the faulting, however, is post-Cape, as the Table Mountain Sandstone is also affected. It is shown that there is a marked similarity in lithological characters and sequence of events shown by the Malmesbury, French Hoek and Klipheuval beds of the Western Province with those of the Pretoria, Rooiberg and Waterberg series of the Transvaal. Dr. Haughton's paper will appear in the *Transactions of the Geological Society of South Africa*.

Steam Tables. The American Society of Mechanical Engineers, with the support of the steam power industries, has taken steps to secure greater reliability in steam tables, and the first contribution to this desired end is a paper in the February issue of the *Journal of Research* of the Bureau of Standards by Messrs. N. S. Osborne, H. F. Stimson, E. F. Fiock and D. C. Ginnings, describing their measurements of the pressure of saturated water vapour from 100° C. to 374° C.—well above the critical point. The static method is used, about 300 gm. of air-free water being enclosed in a shell of chromium-nickel-steel, the temperature of the surface of the water being determined by a platinum resistance thermometer supplemented by thermo elements of 'chromel' and 'copel', and the pressure by a piston loaded with weights. The results are given in tables, the temperature in International Centigrade degrees, the pressure in centibars, and in standard atmospheres and kilograms per square cm. for gravity 980·665. An additional table gives the temperature in Fahrenheit degrees and the pressure in lb. per sq. in. for gravity 32·174. Rates of change of pressure with temperature are also tabulated for thermodynamical purposes. None of the usual formulæ gives the pressure correctly over the whole range of temperature and the authors use a five constant formula with different constants for the ranges 100°–275° C. and 275°–374° C.

Reaction between Hydrogen and Oxygen. Hinshelwood, Moelwyn Hughes and Rolfe (*Proc. Roy. Soc.*, March) have studied the reaction between hydrogen and oxygen in a hot silver vessel. At a temperature of 650° the reaction remained fairly slow, though in a silica vessel at this temperature it would be unmeasurably fast. The explosions which occur for the silica vessel when the pressure lies within a certain range were not obtained with the silver vessel. The reaction always showed behaviour characteristic of a pure surface reaction, and the authors conclude that the silver surface has a powerful effect in breaking reaction chains which are the mechanism of a rapid reaction in the gas phase.

Study of α-Particle Groups. A recent paper from the Cavendish Laboratory deals with the analysis of α-particles by an electromagnet of new design (*Proc. Roy. Soc.*, March). The magnet consists of two bell-shaped pole pieces with a central core carrying the windings. The bells are placed mouth to mouth and an annular region of strong magnetic field is formed between their edges. A field of 10,000 gauss may be produced over an annular region 80 cm. in diameter, 5 cm. wide and 1 cm. deep with an energy of only 200 watts, and α-rays may be analysed by semi-circular focusing as in familiar β-ray apparatus. The source is placed in the annular gap, and diametrically opposite there is a small ionisation chamber connected to a valve amplifier and counting system. Successive groups of α-particles are focused on to the slit of this chamber by adjusting the magnetic field. An arrangement of search coils, fluxmeter and compensating circuit is used to measure the changes in the field. The results obtained are comparable with those obtained by Rosenblum using the great Paris magnet. The fine structure of the α-rays from thorium C is revealed, and the long-range α-particles from radium C^1 and thorium C^1 can be studied. The interest of the investigations lies largely in the relation between α-ray and γ-ray energies, and in some cases satisfactory correlations have already been made between the quantum energies of γ-rays and the energy differences between α-particle groups.

Astronomical Topics

Astronomical Notes for May. Venus is an evening star, but too near the sun for convenient observation. Mars and Jupiter are approaching each other in Leo, but do not reach conjunction until June 4. Mars is 47′ north of Neptune at 8 p.m. on May 16; this may aid observers without circles in identifying Neptune. Saturn, in the eastern part of Capricornus, may be seen after midnight; it is still too far south for convenient observation in England.

The times of disappearance, as seen from London, of four stars occulted by the moon are May 3, 10.31 p.m.; May 5, 8.57 p.m.; May 30, 10.21 p.m.; May 31, 10.17 p.m.; the magnitudes are 6·7, 5·5, 6·2, 7·0.

Two comets are within reach of moderate instruments. Comet Geddes is in Canes Venatici; an ephemeris is given in the B.A.A. Handbook. Comet Pons-Winnecke is in Aquarius; the following ephemeris is for 0^h on the days named:

	R.A.	Decl.
May 4	20^h 56^m 16^s	N. 1° 48′
8	21 17 20	N. 0 25
12	21 36 44	S. 1 1
16	21 56 32	S. 2 28
20	22 15 46	S. 3 55

It is in perihelion on May 18, at a distance from the sun of 102 million miles; this distance has increased by 6 million miles during the last revolution, owing to large perturbations by Jupiter.

To reduce to Summer Time, add one hour to all times given.

Faint Stars with Common Proper Motion. W. J. Luyten has recently published a paper describing a research that he has made with a blink microscope of plates of the region within 30° of the south pole (*Mon. Not. Roy. Astro. Soc.*, Jan.). It contains a list of stars which are concluded to be physically connected from the fact that they have common proper motions of considerable size. The paper attempts to find the probable distances and masses of the stars from a careful statistical study. There are seventy-three pairs which may be confidently taken as physically connected; a few of these had been already announced by other observers.

Two of the new pairs appear to show appreciable orbital motion in the interval of twenty-nine years between the plates; their periods are roughly estimated as 2½–3 centuries, and their parallaxes as about 0·1″ (deduced statistically, not by measurement). Both appear to be dwarf pairs, of the type of Kruger 60; they would repay visual measures with large instruments.

New Proper Motions of Stars from Bergedorf Observatory. Band 7, No. 37 of the *Bergedorf Mitteilungen* contains the seventh instalment of the "Eigenbewegungs-Lexicon". There are 3,757 new proper motions of stars (mostly faint) in the hours 4 and 5 of right ascension. Altogether 45,204 proper motions have now been published in this series. The present list has been compiled by C. Vick under the direction of Prof. R. Schorr. The declinations of the stars lie between 90° North and 1° South; they are arranged in degrees of declination, the reference numbers of the Bonn Durchmusterung being given.

For nearly all the stars observations in the present century are available; the dates of the latest observations for each star are given. Reference is made to the "Geschichte des Fixsternhimmels" for the early observations; the proper motion lists are designed to be used in conjunction with the "Geschichte". They give the magnitudes, the number of observations used for each star, and the proper motion in R.A. and declination in 100 years. No stars with less than three observations are included; generally there are four or five.

Pilot Balloon Observations at Mauritius*

THE study of the upper wind currents over Mauritius with the aid of pilot balloons was begun in July 1925, and the results obtained in the early years have been discussed by Walter and McCurdy (Geophysical Memoir No. 39 of the British Meteorological Office and Miscellaneous Publications of the Royal Alfred Observatory, No. 9 are two of the papers dealing with this subject). In Part 1 of the memoir under review is summarised all the ascents from July 1928 until December 1929 in tables giving the speed and direction of the wind mostly for steps of 500 or 1,000 metres height; and also, in the form of monthly means and frequencies, the results of recent and earlier ascents. As many as 28 ascents have reached a height of 8,000 metres and 80 a height of 6,000 metres; the general summary is taken up to 8,000 metres.

In Part 2 the results are discussed. This discussion is much more thorough than is usual in such work. It is an endeavour to "build up a scheme of the upper wind structure within the tropics and show how the scheme is modified by the seasons", to quote the authors' own words. In it they remark that meteorologists appear to be diffident in applying the geostrophic wind formula—which covers the case of air motion along a great circle—to regions within the tropics, and that their own experience has suggested to them that the isobaric chart between latitudes 5° and 25° S. is normally composed of "straight isobars", to which the geostrophic formula applies, and that the observed winds fit the isobars "at least as well, both in speed and direction, in latitude 5° as in latitude 50°".

They then proceed to derive from the geostrophic formula an expression for the height of the reversal layer between the lower easterly and the upper westerly wind currents over that part of the tropics that lies more than 5° from the equator. The formula obtained is as follows:

$$-\frac{H}{67\cdot4}\cdot\frac{P_0}{(T_h)^2}\cdot\frac{dT_h}{d\lambda}=\frac{dP_0}{d\lambda}$$

where H is the height of the reversal layer in metres, T_h is mean temperature of the air from the surface to height H, in degrees Centigrade absolute, λ is latitude, and P_0 is pressure at sea-level, in millibars.

The values given by this equation after various plausible assumptions such as the constancy of mean horizontal temperature gradients at all heights (based on the known smallness of horizontal temperature gradient at the surface over the tropical oceans, and the probability that lapse-rate varies very little) range from 17,700 metres in latitude 10° to 3,200 metres in latitude 20°.

The authors compare the theoretical figures with those found over various tropical islands, for example at Apia, Guam and Honolulu, and allowing for the seasonal disturbance caused by the shifting of the thermal equator with varying declination of the sun, obtain fair agreement on the whole, though the figures are not applicable in the neighbourhood of large land areas. The work concludes with diagrams showing the observed seasonal variation in the height of the reversal layer over Mauritius, monthly means of velocity up to 8,000 metres, and wind roses up to the same height.

The mathematical analysis in this memoir may possibly be open to criticism here and there, but a serious attempt to go beyond the descriptive stage and to relate local conditions with the general atmospheric circulation is rarely made in papers dealing with upper winds, and is particularly welcome when the region studied forms part of an immense area for which few meteorological data relating to such winds are available.

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* Miscellaneous Publications of the Royal Alfred Observatory, No. 11. "Pilot Balloon Observations at Mauritius." By R. A. Watson and N. R. McCurdy. Pp. 17+3 plates. (Mauritius.)

Sexual Cycle in the Rhesus Monkey

DR. CARL G. HARTMANN has recently published* an account of his detailed investigation of menstruation and pregnancy in the monkey, *Macacus rhesus*. Corner's generalisations concerning the cellular content of the vagina of the monkey are fully corroborated; the leucocyte number falls near the middle of the cycle and the number of cornified cells rises to a peak near the end of the interval. Instead of the vaginal smear method, vaginal lavage has been adopted and has proved more instructive since it enables the cells to be studied in the living condition, vitally stained with methylene blue, which also affords a ready means of differentiating the kinds of cornified cells in the vaginal lumen. The amount of desquamation from the vaginal wall can be quickly read off, after lavage, in terms of the percentage of sediment in the collecting tube. Because of the constancy and reliability of the curve of vaginal desquamation as compared with the character of the cornified cells and leucocytes recovered, the latter are no longer studied and recorded; the amount of desquamation and of uterine bleeding are the two principal factors now studied in menstruating females. When the vagina is practically free of desquamated cells the animal is at a low ebb sexually, and the uterus and ovaries are small and hypofunctional.

Forty-two females, mostly full grown, have furnished data for more than seven hundred menstrual cycles—from a few to fifty-one for the individual females. The average of four hundred cycles for twenty-two of the more vigorous females is twenty-seven to twenty-eight days, but the variations are wide. The average duration of flow approaches four to six days. Dr. Hartmann's paper adds to the literature several hundred proven cases of menstruation without ovulation; the same individual, with regular menstrual rhythm, may alternate ovulatory with non-ovulatory cycles. From an inspection of the ovaries in summer and in winter it was found that the almost complete sterility of the female Rhesus in the warm months of the year was due to her failure to ovulate. A tentative estimate of the age of puberty (the time of the first menstruation) and of maturity (the capacity to ovulate and conceive) is three and four-and-a-half years respectively.

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* Carnegie Inst. of Washington: Contributions to Embryology, vol. 23, No. 134, August, 1932.

Precise data can now be presented on ovulation and conception-time in a menstruating primate. The most exact figures relate to nearly forty cases in which the day of ovulation was precisely determined by palpation, and information almost as exact was furnished by nearly fifty conceptions based on limited mating periods. The optimum conception day is the end of the thirteenth or the beginning of the fourteenth day. The ovaries do not necessarily alternate in ovulation; alternation is the more usual condition but the same ovary may discharge an egg twice or even thrice in successive cycles. The placental sign—due to the leakage of blood into the uterine lumen from dilated uterine glands about the site of implantation, occurred in all the cases of pregnancy observed. The sign is as infallible in the monkey as in the rat, and begins about the time the menses of the animal are due, on the average seventeen days after conception.

The span of gestation in Rhesus, based on thirty cases, is on the average 164 days, but varies with the physique of the individual—the more vigorous individuals keep the fœtus longer. A 6 per cent longer time *in utero* was associated with 26·5 per cent greater birth-weight; the latter is not considered a consequence of the former but both as a function of vigour on the part of the mother. All the mothers nursed their babies when these were viable. Seven months seems to be the usual length of time in which lactation inhibits the menstrual cycle; then cyclic manifestations increase gradually, the ovaries and uterus increase in size, but ovulation may be delayed for months although the menstrual cycle proceeds more or less regularly.

Rectal bimanual palpation of the genital organs is easy to carry out in Rhesus and gives very accurate information about the condition of these organs. It is possible not only to differentiate ovulatory from non-ovulatory cycles but also to determine the exact time of ovulation by the very evident change in size and consistency of the ovary with the collapse of the follicle. After the collapse of the Graafian follicle the corpus luteum may be felt growing from day to day and the uterus keeps pace. Pregnancy may be diagnosed by rectal palpation with relative certainty by the nineteenth day and with practical certainty by the twenty-first day. On the basis of twenty pregnancies a chart has been constructed in which the size and consistency of the uterus and the size of the fœtal head are recorded as found at each of the twenty-three and a half weeks of pregnancy, and the author states that this should enable the investigator, after a single palpation of a pregnant female, to predict the approximate date of birth. The paper is illustrated by six plates and ten figures in the text, and protocols are appended.

Fuel Research

THE Annual Report of the Fuel Research Board for the year ending March 31, 1932 (H.M. Stationery Office. 2*s.* net) refers to the incidence of the financial crisis, which necessitated a retardation of those branches of its activities which seemed less likely to produce immediate practical results.

Apart from the carbonisation plant, referred to below, considerable attention has been given to the study of tar, the most advantageous disposal of which is vital to an industry of low temperature carbonisation. Work is following two lines: (*a*) hydrogenation of the tar to produce Diesel oils and motor spirit, and (*b*) fractional distillation to recover constituents of potential value in chemical industries. The production of road tar is also being studied.

Experiments on the direct hydrogenation of coal are directed towards elucidating the influence of catalysts. Yields of motor spirit up to 145 gallons per ton of coal have been obtained, but the commercial future of the process would be dependent on the existence of a subsidy. The Coal Survey of Great Britain has now been extended to cover the whole of the national coal areas, and progress is being steadily made. This is one of the Board's most valuable tasks, for only those who have considered the selection of coal for special purposes know how limited has been the supply of authenticated data.

The Fuel Research Board has made carbonisation at low temperatures, especially in continuous vertical retorts, one of its chief studies. Cast iron retorts did not prove commercially successful but a new design of firebrick retort has been developed which, after two years' working, is considered very promising. An account of experience with them is given in Fuel Research Technical Paper No. 35, "Low Temperature Carbonisation. Narrow Brick Retorts at the Fuel Research Station" (H.M. Stationery Office. 6*d.*). A wide range of coals—even the most strongly caking —has been successfully carbonised at reasonable speeds, yielding products of satisfactory quality. The use of firebrick instead of iron has been advantageous in allowing the use of higher temperatures, which relieves the operator from many of his anxieties. The report prompts the conclusion that the plant in its evolution tends to approach existing designs of commercial carbonisation plant.

Genetic Studies on *Drosophila*[*]

THIS work referred to below is divided into three portions, dealing respectively with inverted sections of the autosomes in *Drosophila melanogaster*, with translocations between the second and third chromosomes, and with two new lines in which the X-chromosomes of the female are terminally attached to each other. The treatment is highly condensed and technical, with a wealth of new breeding data and some new interpretations.

In 1921, Sturtevant suggested that cases of reduced crossing-over which appeared only in the heterozygous condition might be due to inversion of a section of a chromosome. He has since shown that several such reducers are actually due to an inverted section—so that homologous genes do not correspond in position. In the present paper, sixteen new cross-over reducers in chromosome III are investigated. They fall into three groups and nearly all are shown to result from an inversion of a longer or shorter section. The geographical distribution of reducers in *D. melanogaster* indicates that they must arise independently and fairly frequently. In *D. simulans*, on the contrary, which has an inversion in chromosome III compared with *D. melanogaster*, this is the normal condition of the species, being found in all material collected from many different parts of the United States.

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[*] "Contributions to the Genetics of certain Chromosome Anomalies in *Drosophila melanogaster*." By A. H. Sturtevant and T. Dobzhansky. (Publication No. 421.) Pp. v+81. (Washington, D.C.: Carnegie Institution, 1931.)

The second paper gives a genetical and cytological account of four translocations between chromosomes II and III (the long chromosomes) in *D. melanogaster*. Three of these, which arose in X-ray experiments of Dobzhansky, are called reciprocal translocations. In two of them the chromosomes both broke very close to the (central) spindle-fibre attachment, the two left halves then uniting, and also the two right halves. In the third case, the right half of chromosome III was exchanged with the terminal section of the left half of II. In another translocation, the extreme left end of II was attached to the middle of the left limb of III. These translocations are all lethal when present in the homozygous condition. In some of these translocations the pairing of the somatic chromosomes is different from that of the wild type, like regions of the chromosomes in their new positions tending to lie side by side; and in at least one, certain chromosomes are visibly different in shape from the normal. The bearing of these results on the ring formation of chromosomes in *Œnothera* is discussed.

Two lines with attached X-chromosomes are added to the two already known. They are believed to have arisen from an XX sperm. Triploidy occurred in one of these lines. and the X-chromosomes sometimes become detached, probably in oogonial cells. Three mosaic females were found, probably derived from eggs with two nuclei, as well as several mutations the genetics of which are discussed. R. R. G.

University and Educational Intelligence

Belfast.—Dr. K. G. Emeléus, lecturer in physics, who is at present in the United States with a Rockefeller fellowship, has been appointed to the chair of experimental physics in succession to Prof. W. B. Morton.

Cambridge.—W. V. Lewis, of Gonville and Caius College, has been appointed university demonstrator in geography and Dr. N. W. Pirie university demonstrator in biochemistry.

The Linacre lecture will be delivered by Prof. E. Mellanby on May 6 at 5 p.m. in the lecture room of anatomy. The title of the lecture will be "The Nervous System within the Pale of Nutrition".

London.—The following doctorates have been conferred: D.Sc. degree in biochemistry on Mr. A. G. Norman (Rothamsted Experimental Station) for a published work entitled "The Biological Decomposition of Plant Materials" (*Biochem. J.* and *Ann. Econ. Biol.*, 1929–32); D.Sc. degree in biology on Prof. R. Ruggles Gates (professor of botany at King's College) for published works entitled (1) "The Mutation Factor in Evolution" (Macmillan, 1915), (2) "Mutations and Evolution" (Cambridge University Press, 1921), (3) "Heredity and Eugenics" (Constable, 1923) and (4) "Heredity and Man" (Constable, 1929) and also about 120 scientific memoirs and papers mainly on plant genetics, cytology and human genetics; D.Sc. degree in chemistry on Mr. E. Lester Smith (Chelsea Polytechnic) for fourteen published works on the physical chemistry of soap solutions, emulsions, and the saponification of oils; D.Sc. degree in geology on Mr. B. H. Knight (University College and Chelsea Polytechnic) for a published work entitled "The Road-making Stones of Argyllshire" (*J. Inst. Mun. and City Engin.*, 1932) together with thirty-one other published works; D.Sc. degree in physiology on Mr. R. J. Lythgoe (University College) for a published work on "The Adaptation of the Eye: its relation to the Critical Frequency of Flicker" and "The Measurement of Visual Acuity" (Med. Res. Coun. Special Reports, 134 and 173); D.Sc. degree in veterinary science on Mr. S. C. J. Bennett (Royal Veterinary College) for a thesis entitled "Contagious Bovine Pleuro-Pneumonia: Control by Culture Vaccines" (*J. Comp. Path. and Therap.*, 1932); and Mr. A. W. Stableforth (Royal Veterinary College) for a published work on "Bovine Mastitis" (*J. Comp. Path.*, 1930 and 1932) and "Johne's Disease" ("System of Bacteriology", Med. Res. Coun., 1930); D.Sc. (Economics) degree on Hirendra Lal Dey (London School of Economics) for a thesis entitled "Indian Tariffs in relation to Industry and Taxation" (Allen and Unwin, 1933).

St. Andrews.—At a meeting of the University Court on April 21, a letter was read from Prof. J. E. A. Steggall intimating his retirement from the chair of mathematics in University College, Dundee, as from September 30. The Court, expressing regret at the termination of Prof. Steggall's fifty years' service in University College and its recognition of the admirable work he has done, agreed to accept his resignation and to express to him the hope that he may enjoy his well-earned retirement.

A Bayliss-Starling memorial scholarship for physiology will be awarded shortly. The annual value of the scholarship is about £120, with exemption from tuition fees, and it is tenable at University College, London. The scholar will be required to follow a course of study approved by the Jodrell professor of physiology involving a training in the principles of, and methods of research in, either physiology or biochemistry or both. Candidates for the scholarship must send their applications to the Secretary of University College, Gower Street, W.C.1, on or before May 13.

"The Crisis in Education" was recently discussed at an American Citizens' Conference convened for the purpose at Washington, and Science Service reports that, because of the value of the scientific research conducted in them and of the training for life they afford, the support of universities was strongly urged by a special committee of the Conference. Furthermore, the Conference declared that, during a period of economic stress such as that now existing, there is imposed upon all those in positions of responsibility, whether in government, industrial or cultural activity, a clear duty to promote confidence among the people in their educational institutions. A note of alarm as to symptoms of loss of such confidence is also sounded in the annual report of the Commissioner of Education.

Calendar of Nature Topics

May Sunshine

May in England is primarily the month of sunshine. Although in June the days average nearly an hour longer, the clearer skies of May almost suffice to make up the handicap, and the actual duration of bright sunshine is very nearly as great in May as in June; in some parts of the country May is even the sunnier. This characteristic of "the merry month of May" was early recognised; Shakespeare wrote: "Maids are May when they are maids, but the sky changes when they are wives." May is the last month of spring; the winds have fallen to gentle breezes, but they still blow mainly from south-west. Winds of southerly origin are generally moist, but their stratification is stable, and violent storms are rare. In June, pressure rises over the Atlantic to the west of the British Isles and the prevailing winds blow from north of west; approaching more southerly latitudes the lower layers of air are warmed by contact with the surface and tend to become unstable. Hence in June, skies become cloudier and thundery conditions begin to develop.

Swallow and Cuckoo Arrive

No migrant birds have received more general attention than these, and although consensus of opinion gives April as the usual month of first arrival in Britain, it is curious that the range within the month should be so varied. Dr. Eagle Clarke records the earliest average for the swallow as March 21 for the usual date of first arrival in England, April 6 for Scotland; Gilbert White's dates in Hampshire range from March 26 to April 20; Marwick's in Sussex from April 7 to April 27; Blomefield's in Cambridgeshire from April 9 to April 28, and the Phenological Society's average for thirty-five years works out at April 21. For the cuckoo, the corresponding average is April 26; Blomefield's average of seventeen years is April 29, his range April 21 to May 8, closely corresponding to Marwick's April 15 to May 3, less closely to White's April 7 to April 26.

Precision of Return of Swallow

One of the many interesting discoveries which the ringing method of tracing bird migration has placed beyond doubt is that swallows often return to the exact locality from which they set out in an earlier year. Dr. Landsborough Thomson has summarised the evidence from many sources. In Britain, twenty-one swallows marked as nestlings have been found again at their place of birth, seventeen in the following summer, two after two years, and two after three years, while six marked as adults have returned to the old nesting locality. Sometimes the return was extraordinarily precise, to the same porch or outhouse, sometimes to within a few miles; but occasionally a considerable distance intervened, the two greatest divergences being the return of a bird born in Stirlingshire to Yorkshire (170 miles) and of the recovery of one, born in Ross-shire, at Glasgow (125 miles) after an interval of nine years. In Hungary, von Scoöts recorded many returns of swallows and house-martins of great accuracy, and none outside a radius of two kilometres. In one instance, a bird used the same nest in six successive seasons, and a pair has been observed to keep together for three years. When it is remembered that these returns follow a double journey, to and from southern Africa, under varied conditions of wind, the precision of way-finding and the appreciation of locality take rank as outstanding wonders of bird migration.

Red Deer Shed their Antlers

Richard Jeffries states that the red deer of Exmoor shed their antlers in March, but while this is the shedding month for park deer, in general it may be said that wild stags in England cast their antlers in April and in Scotland in May. In this process, Nature seems to be in wasteful mood, for the building up of a pair of antlers weighing approximately ten pounds, largely from a material so scarce in the food of deer as lime salts, must entail a considerable physiological drain upon the stag. In less than four months, the antler will be completely formed; it will serve its purposes for the remaining eight months and then be entirely cast off.

The shedding of the antlers depends mainly upon the cutting off of the blood supply, and this is brought about by the growth of the bony tissue so that it encroaches upon the blood-vessels lying in the central mass of the antler shaft or beam. The very solid end of a shed antler represents the non-vascular tissue which, in developing, has obliterated the blood-vessels and so cut off the blood supply to the antler, causing it to become a dead structure. Then follows a process analogous to necrosis. At the junction of the antler and the process of the frontal bone upon which it rests, the bone is resorbed and an area of weakness develops, so that by rubbing its antlers against a tree or rock or even by a violent shaking of the head, the stag is able to free itself of them.

Bull Frogs Calling

By the end of April and the beginning of May, the choruses of bull frogs will be in full song in North American swamps, making noise enough to be heard a mile away and almost to deafen observers close at hand. Although frogs, as Sir J. Arthur Thomson used to put it, invented the first love song in the world, they have been able to impart a wonderful amount of variety to their croaking. The song of the Carolina toad (*Bufo terrestris*) may be no more than a slight chirp, but it has also been described, by Prof. A. H. Wright (1932), as a trill, a drone, a musical note in quality or a bass roar, to be interpreted in English (or American) as "waghrrrrrr rrrrrr"; a very different performance from that of the green tree- or 'fried bacon' frog (*Hyla cinerea*) of which the shrill, loud voice, curiously human, seems to call "grab, grab, grabit, grabit". The Carolina toad, like many of the species of *Hyla*, has a large vocal sac under its throat, and when croaking the throat is at first distended to its full capacity and the body compressed, followed by the collapse of the throat and distention of the body. The croak is of seven to nine seconds duration and is repeated at intervals of four to sixty seconds. Temperature readings during the periods of croaking varied from 58° to 88° F., but the best choruses occurred at 68° to 74° or higher. Most of the croaking was preceded or accompanied by rain, or cloudy weather, and rain appears to be the important determining factor. As the season wears on to June and July, croaking slackens in volume, and Wright's data seem to show that the later the season of chorus probably the greater the amount of rain required to give the initial stimulus.

Societies and Academies

London

Mineralogical Society, March 23. L. J. Spencer: Biographical notices of mineralogists recently deceased (fifth series). Max H. Hey: A possible source of error in the determination of symmetry from optical extinction-angles. In certain cases a small departure of a cut plate from the intended section direction may lead to comparatively large errors in the extinction angle and hence to an incorrect determination of symmetry. This is well illustrated by mesolite. Max H. Hey: Studies on the zeolites. (5) Mesolite. New analyses and X-ray studies of mesolite indicate that the correct formula is $Na_4Ca_6Al_{16}Si_{24}O_{80}22H_2O$. There is often a slight replacement of sodium by potassium, and generally an appreciable replacement of calcium by two atoms of sodium. The axial ratio has been determined by goniometric and X-ray methods. Refractive index, birefringence and optical axial angle measurements have been made. The vapour pressure has been studied by the isohydric method previously described. A number of base exchange products have been prepared and the potassium and lithium derivatives shown to be identical with those obtained from natrolite. This provides the first conclusive proof that mesolite and natrolite are, as has been commonly assumed, isostructural. X-ray photographs of mesolite are very similar to those of natrolite, but show distinct differences. The space-group is C_s'. A. E. Mourant: The dehydration of thomsonite. A study of the dehydration of thomsonite by the isobaric method. The results, obtained some years ago, are supplementary to those obtained by Hey by the isohydric method and differ from them in some respects. Dehydrated thomsonite does not absorb air. The lattice-shrinkage reaction has been further investigated. F. J. Turner: Note on the occurrence of piedmontite in quartz-muscovite-schist from the Shotover valley, western Otago, New Zealand. A description of piedmontite in schist occurring as boulders in the Shotover River. The mineral has not previously been recorded from New Zealand.

Paris

Academy of Sciences, March 13 (*C.R.*, **196**, 733-820). Charles Nicolle and J. Laigret: The conservation of various types of typhus virus in the brain of infected rats and guinea-pigs. Marcel Brelot: The problem of Dirichlet. Krawtchouk: The distribution of the roots of orthogonal polynomials. Edm. Lahaye: A method of resolution of algebraical equations. Claude Chevalley: The generation of a topological group by infinitesimal transformations. Nikola Obrechkoff: Meromorph functions which are limits of rational fractions. G. Valiron: Generalisations of theorems of Lindelöf and Phragmén. E. Crausse and J. Baubiac: Transitory regimes in a cylindrical discharge tube containing an obstacle. Albert Toussaint and Henry Giberd: The measurements of the aerodynamical characteristics of the upper and lower wings of 125 biplanes. Henri Poncin: The determination of the movements of a fluid round a cavitation. B. Kwal: The trajectories of the electrons in a longitudinal magnetic field. I. I. Agarbiceanu: The action of the magnetic field on the absorption lines of iodine (I_2). G. Bruhat and A. Guinier: Improvement of the photoelectric polarimeter: the rotatory dispersion of saccharose in the ultra-violet. With the apparatus described, the errors are less than one in a thousand up to a wave-length of 2950 A. and one in five hundred below 2950 A. René Lucas and Marcel Schwob: Anomalous dispersion in magnetic and electric double refraction. A description of the experimental results obtained with fenchone and ethyl phenylsuccinate. The anomalies observed can be explained by the hypothesis of the existence of different molecular forms in equilibrium, these forms possessing Cotton-Mouton constants or Kerr constants of contrary signs. Mlle. M. Quintin: The application of Debye's theory (formula of Gronwall, La Mer and Sandved) to solutions of copper sulphate. The formula of Gronwall and La Mer does not agree well with the facts cited: three hypotheses to account for the disagreement are considered. A. Debierne: New radioactive substances. In the course of chemical treatments of radioactive minerals, the author has noted a certain anomaly in the distribution of activity, and concludes that radium is accompanied by radioactive substances not yet characterised. G. Lejeune: Comparison of the reduction velocities of solutions of ceric and perceric salts by the sugars. Jean Grard: The osmotic pressure of solutions of nitrocellulose. Comparison of osmotic pressure and viscosity of acetone solutions of nitrocellulose before and after heating to 130° C. L. Gay and J. Soulié: A boiling point apparatus for the determination of the dew points and boiling points of mixtures of volatile liquids. Among the advantages claimed for the apparatus figured and described is the maintenance of the state of equilibrium between the vapour and liquid phases, and the uniform temperature in the two phases. Mlle. Choucroun: A correct arrangement for electrophoresis. The apparatus described can be used to concentrate colloids without alteration, and to separate a mixture of two kinds of particles unequally charged. Marcel Godchot, Etienne Canals and Mlle. Germaine Cauquil: The Raman spectrum of some cyclenic hydrocarbons. Data for cyclopentene, cyclohexene, cycloheptene and cyclooctene. B. Bogitch: Roasting sulphides, particularly nickel mattes. N. Yannaquis: The polymorphism of the paraffins. V. Kunzl and J. Köppel: The constant of the crystalline network of the rhombohedral face of quartz. Raymond Hocart: The symmetry of boracite and X-rays. Jacques de Lapparent: The signification of the granulites of Brittany and the genesis of the crystallophyllian. Raymond Furon: The discovery of the fossil-bearing intrusive Cenomanian and new Turonian deposits in the Niger Colony (geological material collected by M. Auguste Chevalier). Marcel Thoral: The discovery of new fossil-bearing deposits in the Potsdamian and lower Arenig of the Montagne Noire. Mlle. G. Homery: The magnetic declination on the whole of the globe. Ch. Maurain: Remarks on the preceding note. Ladislas Gorczynski: The part of the solar radiation diffused by the celestial vault in the total insolation. L. Eblé and G. Gibault: The values of the magnetic elements at the Val-Joyeux station (Seine-et-Oise) on January 1, 1933. Charles Killian: Ecological researches on the seasonal fluctuations of chlorophyll assimilation in plants of the Algerian maquis. Raoul Lecoq: The rôle of the B vitamins in the utilisation of the glycides by the organism of the pigeon. The comparative action of levulose, glucose, galactose and of some dissacharides (holosides) incorporated in balanced regimes, rich in lipides. P. Cappe de Baillon: The formation of the egg-shell in the Phasmidæ. Mme. Louise Nouvel: Casting the shell of *Leander serratus* affected with the parasite *Bopyrus Fougerouxi*. The growth and casting the shell in *Leander* is in no way influenced by the presence of the parasite. J. André Thomas: The pure culture of the umbilical vitellin syncytium of the embryo of the fowl. The first stages. Mlle. A. Kramer: Contribution to the study of the heterosides of *Philyrea latifolia*. Two heterosides have been extracted from the bark of *Philyrea*, one named philyroside identical with the philyrine of Carboncelli and of Bertagnini and Luca, another proved to be identical with syringoside (syringine) isolated from various plants of the Oleaceæ. C. Charaux and J. Rabaté: Contribution to the biochemical study of the genus *Salix*. Isosalipurposide. H. Bordier: The continuity of Merget's phenomenon.

SYDNEY

Linnean Society of New South Wales, Nov. 30. H. L. Jensen: Contributions to our knowledge of the Actinomycetales. (4) The identity of certain species of *Mycobacterium* and *Proactinomyces*. A number of organisms previously described as species of *Mycobacterium* were found, on account of their definite mycelial growth in the initial stages of their life cycles, to have their proper place in the genus *Proactinomyces*. *M. agreste* Gray and Thornton and *B. mycoides corallinus* Hefferan must be regarded as one species, *P. corallinus*. *M. salmonicolor* den Dooren de Jong is closely related to this and should be called *P. salmonicolor*. *M. opacum* den Dooren de Jong and *M. crystallophagum* Gray and Thornton are identical; this species should be called *P. opacus*. *M. erythropolis* is closely related to this; its proper name should be *P. erythropolis*. *Microbacterium mesentericum* Orla-Jensen showed a very distinct mycelial growth and should be called *P. mesentericus*. T. G. B. Osborn, J. G. Wood and T. B. Paltridge: The growth and reaction to grazing of the perennial saltbush, *Atriplex vesicarium*. An ecological study of the biotic factor. The root system is extensive and superficial, with deciduous feeding roots. The leaves, which are non-cuticularised with a high salt content, are able to absorb water vapour from a nearly saturated atmosphere. The plant is, indeed, dependent for a portion of its water upon moisture absorbed from the air. With continued drought and loss of vegetative vigour it passes through states of wilting, defoliation and anabiosis. Moderately heavily grazed saltbush is more vigorous during a drought period than lightly grazed bush or bush that is not grazed at all. Saltbush is most profitably utilised under a system of moderately heavy intermittent grazing. J. G. Churchward: The geographical distribution of *Tilletia* species on wheat in Australia in 1931. Two species of *Tilletia*, namely, *T. tritici* and *T. levis*, are widely distributed and prevalent in most of the wheat-growing areas of Australia. This fact has an important bearing on the development of disease-resistant varieties, as it has been shown by Johnston (1924), Kienholz and Heald (1930), and Holton (1930), that varieties do not necessarily react in the same way to the two species of bunt. I. M. Mackerras: The Australian species of *Graphomyia* (Diptera, Muscidæ). One species of *Graphomyia* from North Australia is described as new. G. A. Waterhouse: Australian Hesperiidæ (3). New subspecies are described as follows: two of *Trapezites symmomus*, one of *Netrocoryne repanda*, and a new form of *Euschemon rafflesia*.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, 677–730, Dec. 15, 1932). Barbara McClintock: A correlation of ring-shaped chromosomes with variegation in *Zea mays*. Diminution in size or loss of the ring chromosomes was observed in eight cases, seven of them the progeny of X-rayed pollen. This leads to variegation if the ring carries a 'genetic marker'. M. Biot: Critical torsional oscillations of a rotating accelerated shaft. A theoretical discussion, assuming the forces applied to the shaft have a part (a moment of constant amplitude per unit length) varying with a frequency proportional to the angular velocity, and neglecting damping. Benjamin Kropp: The crustacean chromatophore activator and the gonads of the rat. Active extract from the eye-stalk of *Palæmonetes*, though like pituitrin causing melanophore movements in fishes and tadpoles, has no observable effect on the gonads of rats. Matilda Moldenhauer Brooks: The penetration of *m*-bromo-phenol indophenol and of guaiacol indophenol into *Valonia ventricosa*. Both these dyes penetrate the cells and are found inside in the reduced form. Kenneth V. Thimann and James Bonner: Studies on the growth hormone of plants. (2) The entry of growth substance into the plant. Curvature of oat coleoptiles is proportional to the concentration of growth substance supplied in solution in agar blocks. A theoretical discussion brings Went's observations, which suggested that the amount of growth substance was the effective factor, into line with the new results. Hudson Hoagland: Impulses from sensory nerves of catfish. Electrical responses were recorded from lateral line nerves, spinal nerves supplying skin of flank, and branches of the facial supplying tastebuds of lips and barbels, after mechanical, thermal and chemical stimulation of the receptors. The lateral line nerve appears to be in a state of continuous spontaneous activity and the individual neuromasts can be synchronised by a tuning fork. The system, contrary to the facial and spinal nerves, seems to be a thermal receptor. Karl T. Compton: Accommodation coefficient of gaseous ions at cathodes. An ion entering the positive ion space charge sheath round a cathode acquires a certain momentum and strikes the cathode; after neutralisation, it may leave the cathode with appreciable energy, a point hitherto neglected. Of the impulse given to the cathode, part is exactly compensated by the mutual pull of cathode and ion during approach and the remainder alone contributes to the pressure on the cathode. The effect is described in terms of the 'accommodation coefficient' used to give the energy transfer of gas molecules at temperature T_1 striking a surface at temperature T_2 and leaving at temperature T_2. Gustav A. Hedlund: Recurrent geodesics on any closed orientable surface of genus one. W. J. Trjitzinsky: (1) The general case of integro-Q-difference equations. (2) A property of indefinitely differentiable classes. H. R. Brahana: Operators of order p^m in the group of isomorphisms of the Abelian group of order p^n and type 1, 1, . . . Marston Morse and S. B. Littauer. A characterisation of fields in the calculus of variations. Dealing with a geometric characterisation of focal points and conjugate points in n-space for $n > 2$.

Forthcoming Events

Monday, May 1

National Institute of Industrial Psychology, at 6—(at the London School of Economics, Houghton Street, W.C.2).—C. B. Frisby : "The Internal Economy of the Office".

Royal Geographical Society, at 8.30.—A. V. Coverley-Price and Miss M. McKinnon Wood : "Professor Gregory's Expedition to Peru".

Tuesday, May 2

Institution of Civil Engineers, at 6.—(James Forrest Lecture.) Sir Harold Hartley : "Recent Advances in the Application of Chemistry to Engineering".

Wednesday, May 3

Eugenics Society, at 4—(at the rooms of the Linnean Society, Burlington House, London, W.1).—Annual General Meeting.

Bedford College for Women, at 5.15.—Prof. E. A. Bott : "Principles of Critical Analysis in Relation to Modern Psychology" (succeeding lectures on May 4 and 5).

Royal Society of Arts, at 8.—Prince Ginari Conti : "The Natural Steam Springs of Tuscany and their Industrial Application".

Thursday, May 4

Huxley Memorial Lecture, at 5.30—(at the Imperial College of Science and Technology).—Prof. H. E. Armstrong : "Our Need to Honour Huxley's Will".

University of London, at 5.30—(at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1).—R. Freeman : "Long Span Bridges".

Friday, May 5

London School of Hygiene and Tropical Medicine, at 3.15.—Dr. E. L. Middleton : "Industrial Hygiene" (succeeding lectures on May 12, 19, 26 and June 2).

Chemical Society, at 5.15—(joint meeting with the University College of North Wales (Bangor) Chemical Society at the Memorial Science Buildings, Bangor).—Prof. C. S. Gibson : "The Chemistry of Gold".

Geologists' Association, at 7.30—(in the Architectural Theatre, University College, Gower Street, W.C.1).—Sir Albert E. Kitson : "A Geological Reconnaissance through Kenya, British East Africa".

Saturday, May 6

University of Cambridge, at 5—(in the Anatomy Lecture Room).—Prof. E. Mellanby : "The Nervous System within the Pale of Nutrition" (Linacre Lecture).

Entomological Society of London, May 3–4.—Centenary Celebrations at rooms of the Royal Geographical Society and Lancaster House, St. James's, S.W.1.

Electrical Association for Women, May 3–5. Eighth Annual Conference to be held at Birmingham. President : Dame Ethel Shakespear.

Iron and Steel Institute, May 4–5. Annual Meeting. W. R. Lysaght—Presidential Address.

Official Publications Received

GREAT BRITAIN AND IRELAND

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 6 (New Series), No. 2, February. Abstracts Nos. 194–373. Pp. 37–72. (London : H.M. Stationery Office.) 1*s*. 3*d*. net.

Ollscoil Na h-Eireann (The National University of Ireland). Calendar for the Year 1932. Pp. viii+299+588+260. (Dublin.)

Proceedings of the Geologists' Association. Edited by G. S. Sweeting. Vol. 44, Part 1, March 29th. Pp. 120. (London : Edward Stanford, Ltd.) 5*s*.

British Cast Iron Research Association. Special Publication No. 1. Recommended Methods for Sampling and Analysis of Cast Ferrous Metals and Alloys. Pp. 44. (Birmingham.) 10*s*. 6*d*.

Journal of the Chemical Society. March. Pp. iii+217–382+x. (London : Chemical Society.)

Quarterly Journal of the Royal Meteorological Society. Vol. 59, No. 249, April. Pp. 95–200. (London : Edward Stanford, Ltd.) 7*s*. 6*d*.

OTHER COUNTRIES

Colony and Protectorate of Nigeria. Report on the Agricultural Department for the Year 1931. Pp. ii+30. (Lagos : C.M.S. Bookshop ; London : The Crown Agents for the Colonies.) 2*s*. 6*d*. net.

Report on the Administration of the Meteorological Department of the Government of India in 1931–32. Pp. ii+34. (Calcutta : Government of India Central Publication Branch.) 8 annas ; 10*d*.

Government of India : Department of Industries and Labour. Functions and Organisation of the India Meteorological Department, 1933. Pp. 19. (Simla : Government of India Press.)

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1932. Pp. 18+5 plates. (København : G. E. C. Gad.)

Japanese Journal of Astronomy and Geophysics. Transactions and Abstracts, Vol. 10, No. 2. Pp. ii+81–303+17–27. (Tokyo : National Research Council of Japan.)

The Museum Journal. Vol. 23, No. 3 : Excavations at Ur, by C. L. Woolley ; The Pottery of Tell Billa, by E. A. Speiser. Pp. 185–312 (plates 26–72). (Philadelphia : University Museum.) 1 dollar.

Ministry of Public Works, Egypt ; Physical Department. Physical Department Paper No. 28 : The Nile Basin. Vol. 2 : Measured Discharges of the Nile and its Tributaries. By Dr. H. E. Hurst and Dr. P. Phillips. Pp. ix+661. (Cairo : Government Press.) P.T. 50.

History, Ethnology and Anthropology of the Aleut. By Waldemar Jochelson. (Publication No. 432.) Pp. vi+91. (Washington, D.C. : Carnegie Institution.)

U.S. Department of the Interior : Office of Education. Bulletin, 1932, No. 9 : Nursery Schools ; their Development and Current Practices in the United States. By Mary Dabney Davis, with the collaboration of Rowna Hansen. Pp. v+92. (Washington, D.C. : Government Printing Office.) 15 cents.

Smithsonian Miscellaneous Collections. Vol. 89, No. 1 : Amphibians and Reptiles collected by the Smithsonian Biological Survey of the Panama Canal Zone. By Karl Patterson Schmidt. (Publication 3181.) Pp. 20. (Washington, D.C. : Smithsonian Institution.)

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 21, No. 6 : The Templeton Crocker Expedition of the California Academy of Sciences. No. 6 : Formicidæ of the Temple Crocker Expedition. By Prof. William Morton Wheeler. Pp. 57–64. (San Francisco.)

Proceedings of the American Academy of Arts and Sciences. Vol. 68, No. 1 : The Pressure-Volume-Temperature Relations of Fifteen Liquids. By P. W. Bridgman. Pp. 26. 60 cents. Vol. 68, No. 2 : Compressibilities and Pressure Coefficients of Resistance of Elements, Compounds and Alloys, many of them Anomalous. By P. W. Bridgman. Pp. 27–94. 1.20 dollars. Vol. 68, No. 3 : The Effect of Pressure on the Electrical Resistance of Single Metal Crystals at Low Temperature. By P. W. Bridgman. Pp. 95–124. 75 cents. Vol. 68, No. 4 : Radioactivity Measurements. i. The Radium Content of the Keweenawan Basalts and some Accessory Minerals ; ii. The Occurrence of Radium, Uranium and Potassium in the Earth. By Wm. D. Urry. Pp. 125–144. 50 cents. (Boston, Mass.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 85. Descriptions of New Birds from Peru, with Notes on other Little-known Species. By M. A. Carriker, Jr. Pp.38. (Philadelphia.)

Proceedings of the United States National Museum. Vol. 82, Art. 6 : Two Nematodes, and Notes on New Findings of Nematodes Parasitic in Amphibia. By A. C. Walton. (No. 2947.) Pp. 5. Vol. 82, Art. 8 : New Fresh-Water Gastropod Mollusks of the Genus Chilina of South America. By William B. Marshall. (No. 2949.) Pp. 6+1 plate. Vol. 82, Art. 9 : A New Species of Extinct Turtle from the Upper Pliocene of Idaho. By Charles W. Gilmore. (No. 2950.) Pp. 7+3 plates. Vol. 82, Art. 10 : A Collection of Birds from Great Namaqualand, South-west Africa. By Herbert Friedmann. (No. 2951.) Pp. 12+1 plate. Vol. 82, Art. 12 : Fossil Plants from the Aspen Shale of Southwestern Wyoming. By Roland W. Brown. (No. 2953.) Pp. 10+2 plates. Vol. 82, Art. 13 : Camptostroma, a Lower Cambrian Floating Hydrozoan. By Rudolf Ruedemann. (No. 2954.) Pp. 8+4 plates. Vol. 82, Art. 14 : Descriptions of New Ichneumon-Flies, with Taxonomic Notes. By R. A. Cushman. (No. 2955.) Pp. 16. (Washington, D.C. : Government Printing Office.)

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Heffer's Book Adviser, March 1933. (Catalogue 407.) Pp. 12. (Cambridge : W. Heffer and Sons, Ltd.)

Standard Catalogue of Scientific Apparatus. Vol. 1 : Sections 1–15, 30–32. Pp. xvi+1466+2490–2590+120+xvii–lxviii. Vol. 2 : Sections 20–26, 32. Pp. 1569–2100+lxxi–xc. (London : Baird and Tatlock (London), Ltd.)

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The Utilisation of Coal*

THE British Science Guild has now published the full text of the papers delivered, and a verbatim account of the subsequent discussion, at the symposium on the utilisation of coal, held at the Royal Institution on March 27, a report of which appeared in NATURE of April 1. Members of Parliament; some of the largest trade unions; interested Government departments; coal-getting and coal-distributing organisations; gas, oil and chemical interests; scientific and technical institutions, were all well represented, a fact which should encourage the Council of the Guild to arrange more meetings of this kind on subjects of national importance and where scope is given for the expression of varying opinions and differing interpretations of available data. It is the object of the British Science Guild to promote the application of scientific method and results to public affairs, and probably there is no surer way of appealing to the public imagination than by providing facilities for experts to express in terms intelligible to the layman the effects of their investigations on industrial aspects of national progress.

While, however, we must congratulate the British Science Guild on arranging a symposium on a subject of such interest as to prevail upon so many busy and distinguished persons to forsake all other duties to be present, we must confess to a feeling of disappointment that the expert protagonists of coal and oil and gas, and most of those authoritative experts who contributed to the discussion, made such poor use of the exceptional opportunity afforded them. Engineer Rear-Admiral Scott-Hill's paper on "Coal and Sea Transport" was the only contribution of real merit, noteworthy alike for its substance, the impartiality with which he assessed the relative advantages of coal and oil as fuels for the mercantile marine and the navy, and the suggestions made for the extended use of coal. The paper by Mr. Stephen Lacey, of the National Gas Council, on "Development of the Use of Gas", exhibited the same regard for accuracy but it presented no new features and dealt far too briefly with either the possibilities of high pressure gas cylinders for lighting and power purposes, or those of high pressure gas mains for distributing heat, light and power direct from coal-fields to the towns and other industrial centres, of which the practical possibilities have already been demonstrated in Germany.

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* "A Symposium on the Utilisation of Coal." Pp. 46. (London: British Science Guild, 6 John Street, Adelphi, W.C.2.) 1s.

Capt. Acworth and Mr. A. C. Hardy have been in the lists before as protagonists of coal and oil respectively. It is unfortunate that both these experts preferred to indulge in polemics instead of providing the audience with complete comparative data from which the experts and laymen present could have drawn their own conclusions. In his enthusiasm for a 'Back to Coal' movement Capt. Acworth made assertions to which even a back-bench politician would hesitate to commit himself. We do not question the fact he gave that Great Britain's annual output of coal decreased from 287,000,000 tons in 1913 to less than 220,000,000 tons in 1931. But his paper contained no justification for his conclusion that "considerably more than 67,000,000 tons of British coal has thus been replaced by oil". Again, his statement that since 1913 "the change over on sea and land from coal to oil has adversely affected our national trading balance by £960,000,000" should not have been made without his audience being informed of the statistics on which he based this estimate.

Capt. Acworth asserted also, in support of his argument, that the oil industry has been subsidised at the expense of the British taxpayer, that "In this country alone £1,600,000,000 has been expended in making the roads fit for motor-traction", a total which obviously includes expenditure on making and upkeep of roads which would have been incurred if the motor-car had never been invented. Although Capt. Acworth believes that "low temperature carbonisation has a considerable future if the solid fuel is treated as the main product", he discounts the possibility of the mercantile marine and navy obtaining their supplies of oil by this process of extraction from home-produced coal and dismisses as fantastic the economic practicability of obtaining oil from coal by the hydrogenation process.

Mr. Hardy was guilty of at least two important omissions in his own contribution, both of which unfortunately passed without comment. In the first place he made no reference to the decision of one of our greatest ocean liner companies to experiment with pulverised coal and colloidal fuels; and in the comparative figures he gave of fuel consumption by coal-burning, oil and Diesel ships, he made no reference to the relative costs of coal and oil and the running expenses of the three different types of marine engines. It is surprising also that he did not refer at all to the possibility of obtaining our oil supplies from our own coal. Curiously enough, Mr. Stephen Lacey made no mention of the part played by the gas companies in connexion with home-produced hydrocarbons. Neither did he deal with the economics of the other by-products of coal in relation to the coal-gas industry.

Mr. Hardy fell into the grave error of assuming that any body which offers the expert exponents of competing industries an opportunity to inform public opinion on recent advances in the fields of enterprise in which they are interested, necessarily subscribes to their views or vouches for the accuracy of the data which they use in their papers. *Petroleum Times*, in its issue of April 1, made the same error. Commenting on Capt. Acworth's paper, it said: "rarely, if ever, can coal and oil technologists have listened to so many mischievous and distorted statements"; and added, "we are left with a deep conviction that the British Science Guild has lowered its reputation by allowing such distortion to pass out under its name". The fact is, the British Science Guild provided a platform for a controversy which is of vital interest to the nation, and it was evident from the company which assembled that pains had been taken to ensure that in the audience were experts who could, if they had chosen, challenge the accuracy of the data given and comment on the conclusions drawn, by those who read papers.

Unfortunately, however, most of the experts who contributed to the subsequent discussion were apparently more concerned to prove that the coal-owners and distributors are largely responsible for the present unsatisfactory situation of the coal industry than to enlighten the audience on the relations between the coal industry and the oil and the chemical industries. The dyestuffs industry was not even mentioned: and only casual reference was made to low temperature carbonisation and hydrogenation of coal, although these two processes have been the subject of comment and controversy for years past. This is a great pity, for there are very many people in Great Britain who wish to be informed on the economics of oil from coal projects, more particularly as seventy per cent of our imported oil supplies come from the United States of America, to which we are already heavily indebted and to which we are unable to sell much in exchange owing to the prohibitive tariffs.

Civilisation and War

They that take the Sword. By Dr. Esmé Wingfield-Stratford. Pp. xv+422. (London: George Routledge and Sons, Ltd., 1932.) 12*s*. 6*d*. net.

ONE of the principal arguments of this book is that the next war on the grand scale will mean the complete annihilation of modern civilisation; a phrase easily uttered, but the terrible significance of which is not easily apprehended. Probably by the cynics and pessimists among us it will be so little apprehended that this particular argument will make no very profound or soul-stirring appeal. They will at once agree that our civilisation, such as it is, deserves no other fate, which is, in any case, inevitable. This, however, is a question of fundamental philosophy or historical interpretation which is perhaps beyond our present scope, and, as the author of this powerful denunciation of war in all its aspects has done, it is taken for granted that civilisation must be saved.

If reasoned argument and moving eloquence alone could abolish war, then war would long ago have been abolished, or if not, this book would surely finish the perfect work. As a reasoned statement of the case against war these scholarly and persuasive pages could scarcely be surpassed in strength and lucidity and cogency of argument, in splendid wealth of apt illustration and historical lore, and in devastating logic against the folly and madness of war from every point of view; or, from nearly every point of view: there are one or two aspects which, as noted later on, do not appear to us to be sufficiently treated. No rational mind in its calm moments could for one instant dispute or deny the truth, wisdom, broad-minded charity, and profound scholarship breathing in every page. In both breadth of learning and scope and in depth of philosophical reasoning the book is remarkable, though the author's attitude towards Old Testament Hebrew history may be unpalatable to some; and alike for the general reader and the student of history the keenest interest is sustained to the very end, despite its more than four hundred closely printed pages.

To the man of science the work will be of particular interest. Dr. Wingfield-Stratford's main thesis indeed is that, chiefly owing to scientific progress, the fabric of civilisation tends to become ever more liable to fatal injury with increasing development in extent and complexity; the powers of destruction and self-destruction conferred on mankind by science are continually increasing; and the combination of these two tendencies must mean annihilation (p. 378). Whilst apparently accepting the evolutionary doctrine in the main, the author nevertheless holds that "progress in evolution is a progress in unity, in co-operation, in the membership of each in all, in the fulfilment of every lesser individuality in a greater, until God, the supreme and ultimate unity, shall be all in all". There is no basis in fact for the so-called economic theory of enlightened selfishness—which was often extremely dark and unenlightened, expressing itself in cut-throat competition. The respective merits of competition and of co-operation in all their manifold complex forms are vital factors in any discussion of war; and a growing realisation of international dependence and the advantages of co-operation as against trade war is one of modern civilisation's hopes, though unfortunately, at the moment, this realisation is more in theory than in fact.

The alleged Darwinian necessity of a struggle *à outrance* for survival has by no means been universal; and the author brings all the weight of his wide historical knowledge in support of this view, as also against the popular fiction of a pugnacious and ruthless club-wielding caveman. Thence he argues against the supposed inherent love of fighting in human nature. Even if this latter propensity be real it could play no part in, nor derive any satisfaction from, the nameless horrors of modern mechanised warfare. Its proper sphere is the boxing ring or other place of sport, and it is as little intended for the shambles of a modern battlefield as a high-spirited dog is intended for the abattoir of the butcher. Courage, strength, skill, stand as little chance in the one as in the other.

Sir Norman Angell long ago showed the great illusion of war from a material point of view. This needs no further emphasis in these days when even victory brings no gain, but irreparable loss. Dr. Wingfield-Stratford now, with masterly analysis and illustration, in his chapters on the mind and soul of the soldier, brings into startling visibility the repressing and stultifying effect of military preoccupations on the mentality of the professional soldier, and, more generally, the tragic bar to national progress and culture formed by diversion of so much of the nation's energy into military channels. He is particularly severe against Napoleon and other "conquering heroes", whose reputations for real greatness are shattered in this book with the enthusiasm of an iconoclast.

It is not, of course, possible to follow the author wholeheartedly in every point he endeavours to make; there will be dissent from the sweeping condemnations contained in the chapters just referred to on the professional soldier's mentality. Some exceptions are indeed admitted by the author himself. In any event, his remarks on the attitude of the military mind towards scientific advance in the arts and mechanised means of war will be read with marked interest. As a general rule he thinks the military mind is too low-grade and undeveloped to understand or appreciate scientific help.

Then again, despite his breadth of treatment, touching, it would seem, every possible aspect of a highly complex subject, the author does not appear to treat very adequately of what may be called defensive wars. There have been, of course, in the past and may well be again in the future, cases of unprovoked assault in which the attacked nation could do no other than defend itself. Also should not the weak nation be protected against the strong and ruthless aggressor? These and many other difficult matters of a highly controversial kind necessarily go to the heart of the *raison d'être* of the League of Nations, its policy and methods.

Dr. Wingfield-Stratford is mainly concerned in stating the case against war: he does not say a great deal as to practical measures for ensuring peace, except world-wide and enthusiastic support for the League and a change in spirit. It should, no doubt, be sufficient for all reasonable men to realise the full significance of another world-war to ensure the complete abolition of war. Unlike all wars of the past, the next war may include the exposure of the entire civilian populations to the horrors of air-bombing and poison gas on a scale not yet known or realised. Is further appeal needed? Civilisation would indeed be utterly destroyed amid every circumstance of unmitigated horror and terror, and the fate of the world in such case could scarcely be depicted in too lurid colours. The most powerful safeguard to ensure world peace is, in the author's opinion, a change in spirit worked by a full and complete return to the teaching and practice of the founder of Christianity.

W. G. L. C.

The Naturalist and the Country Side

(1) *The Common Earth.* By E. L. Grant Watson. Pp. xi+148. (London: J. M. Dent and Sons, Ltd., 1932.) 5*s*. net.

(2) *The Trail that is Always New.* By Willoughby P. Lowe. Pp. xix+271+22 plates. (London and Edinburgh: Gurney and Jackson, 1932.) 16*s*. net.

(1) THIS little book is made up of essays on English country life, which were broadcast in 1931–32. They are pleasantly written observations on the seasons, on animal, bird and insect life, and on the life-history of a typical old peasant. Such lectures do not aim at the revelation of anything new, but we take it were given with the object of arousing the interest of the townsman, and of the otherwise unobservant person, in the many attainable delights of a lover of the country.

The author tells his stories of animals and of his country rambles so attractively, that the reviewer regrets his occasional excursions into philosophical surmise, and agrees with his assertion that feelings aroused by observation of Nature cannot be put into a few simple words. Thus after about two pages on the starlit sky, we read: "As we gaze, the persuasion grows that all these marvels of the sky are under-arched and upheld by the no less potential vastness of mind which perceives them." Here surely the words convey no clear meaning or feeling at all. In describing autumn, the author emphasises the steps taken in Nature to ensure the fall of the leaf, etc., and then remarks: "In this widespread seasonal act of deliberate dying, nature is saying something with no uncertain voice. It is worth listening to." Surely Nature is saying that the fall of the leaf is no more a deliberate act of dying than is the moult of a bird, or perhaps the hibernation of an animal.

Mr. Grant Watson has the power of sharing his pleasure in birds and beasts with his reader. We know that he has respect and affection for wild life, so that his last chapter—on Wicken Fen—gives us the more surprise. He refers to "these good days when one could see as many as twenty sheets on the fen at night with lamps in front of them"—these being provided by one Solomon Bailey at a cost of half a crown each, with the object, be it noted, not of the observation of wild life, but of the ruthless slaughter of as many rare moths as possible. He himself thus captured the rare *palustris* which only appears every seven years or so, and then only in ones and twos for one week in June.

The reviewer hoped against hope that a word of appreciation for the work of the National Trust in preserving the wild life would have shown that the words "these good days" were writ "sarcastic-like". Entomologists, naturalists, botanists, all are welcomed to Wicken, without the half-crowns, provided that they come to *learn*, not to destroy, to observe and commune with Nature rather than to kill her children for pecuniary gain as so often in "these good days".

(2) Mr. Willoughby Lowe was bred in Lincolnshire, but in 1888, when only sixteen, joined a brother in Colorado. Here he lived for nine years, collecting, communing with Nature and learning that reliability and assurance of self to which he many times afterwards owed his life. It was a wild, open country and no better training ground can be imagined with its plains and heights, its summers of drought and its winters almost glacial. In 1912 commenced an honourable connexion with the British Museum, the collections of birds and mammals of which he so greatly enriched.

Many lands were visited, even Siam and the Philippines, but perhaps the reader will be most interested in the repeated investigations of African life. After a trip in East Africa in 1913, he travelled from Lake Rudolf to the Nile through waterless and dangerous country, from which the party was fortunate to emerge. When returning home, Lowe met Abel Chapman, another fine naturalist, with whom he collected afterwards in the Sudan. The biggest venture was in 1920 with Admiral Lynes to Darfur, where they were detained owing to the rebellion of 1921, the expedition extending over eighteen months. The haul here was 365 species of birds and 62 mammals, many hitherto undescribed. The west coast of Africa was visited many times, and extensive collections were also made in Madagascar, in parts the wildest of countries.

Then "farewell" to the reader without fuss for the trail is calling, "this time to the borders of China". Perhaps later Lowe will reflect on his life, all he has time to add here being a few health hints which we summarise as recommending warm baths, as little exposure to the sun and insect bites as possible, equal parts of penny royal and olive oil to deter mosquitoes, boiled water, 5 grains of quinine per day, and *one* peg of whisky but "never before sundown".

We confess that we did not expect to enjoy the story of a collector's expeditions, but Mr. Lowe has written such a simple, unaffected narrative that he has disarmed us. He is primarily a naturalist as indeed the successful collector must be, and his tale excited us in the same way as did Wallace's "Amazon", more than forty years ago. The science of both these 'travels' consisted of the facts observed, and the 'how, when and why' of the pseudo man of science, usually mere guess-work, is eschewed. All naturalists will like to have this book on their shelves.

Relativity and the Structure of the Universe

The Expanding Universe. By Sir Arthur Eddington. Pp. ix+128+2 plates. (Cambridge: At the University Press, 1933.) 3*s*. 6*d*. net.

SIR ARTHUR EDDINGTON'S skill as a writer is well known to-day. He makes effective use of it in this brilliant exposition of the theory of the structure of the universe from the point of view of the theory of general relativity. The observational problem to be discussed is becoming familiar to all scientific workers. Our galaxy is apparently surrounded by a cloud of other galaxies, the spiral nebulæ, which appear to be evenly scattered throughout space. This cloud, moreover, does not seem to have a boundary. The spectral lines of the light emitted by these nebulæ exhibit a shift towards the red end of the spectrum which increases proportionately to the distance of the nebula concerned. By means of the Doppler effect in the wave theory of light, this observed red-shift is interpreted as a velocity of recession. The speeds so found are enormous: the most recent determination is 24,000 km./sec. for a faint cluster of nebulæ in the constellation Gemini. With this interpretation of the red-shift, we are evidently dealing with a material system which is certainly expanding and is also boundless.

Sir Arthur Eddington points out that the existence of such a system of material particles (the nebulæ) which has no boundary and in which each particle is uniformly surrounded by all the rest, implies that the system occurs in a curved and closed space. If each particle sees all the others moving away from it with velocities proportional to their distances, the space must be expanding as well as closed. Of course, it is always open to those who have preconceived ideas as to what space 'ought' to be, to represent this curved space as 'flat' by introducing appropriate distortions, just as the curved surface of the earth may be mapped on a flat plane. But the relativist will not feel called upon to do this. The equations of general relativity not only expressly allow for the possibility of using curved spaces, but also contain the cosmical constant $\lambda\ (> 0)$ which suggests that such spaces may be 'expanding'. Roughly speaking, the presence of the 'λ-term' in the equations is tantamount to the assumption that, in addition to the gravitational attraction between particles of matter, there exists a universal repulsive force which will cause a general scattering of any collection of particles provided it can get the upper hand of their mutual attractions. In the physical universe this is supposed to have happened, with the result that all the nebulæ now appear to be receding from us.

It is possible to imagine a state of affairs in which, throughout the whole universe, gravitation and repulsion just balance one another. This is the so-called Einstein universe. Space is then spherical and the condition is one of unstable equilibrium, so that the slightest disturbance in the appropriate direction will start an expansion. Sir Arthur Eddington considers that physical space started from such an equilibrium state. This has the advantage, amongst others, of giving the longest time-scale yet proposed (some 10^{10} years) since the expansion effectively began.

The last chapter of the book is devoted to Sir Arthur Eddington's own investigations on the border-line between relativity and quantum mechanics. The wave-equation for an atom gives the size of the latter. Sir Arthur believes that a 'length' at any point in space must be relative to the radius of curvature of space-time at that point. Hence the wave-equation must contain this radius. It must also involve something representing the action on the atom of the rest of the universe. It is then possible to deduce, from the constants occurring in the wave-equation, the value of the velocity of recession of the spiral nebulæ and the number (10^{79}) of the protons and electrons in the universe. These results are, as yet, not universally accepted but there can be little doubt that they point towards the goal so long sought after: the all-embracing theory which shall account for both the microscopic and the macroscopic phenomena of Nature. G. C. McV.

Short Reviews

Indian Caste Customs. By L. S. S. O'Malley. Pp. ix + 190. (Cambridge: At the University Press, 1932.) 6*s*. net.

MR. O'MALLEY quotes a remark by Lord William Bentinck, when the prohibition of suttee was under consideration, that the question was not what the rite was, but what it was thought to be. His own account of Indian caste customs is quite in this spirit. His object is to show how the caste system works in the everyday life of India, without entering into any inquiry as to origins, or the origin of specific castes and groups except in so far as present conditions are thereby affected. He writes for those whose knowledge of caste is at best superficial, and shows how it works in the spheres of social position and intercourse, marriage and morals, internal regulation and external control, food and drink, and occupations.

A chapter is devoted to the Untouchables, and one to modern tendencies, in which it is pointed out to what extent caste regulations are now breaking down. Here, in view of the public for whom the author writes, even more stress might have been laid upon the weight of conservatism in the rural population, which constitutes nine-tenths of the whole Hindu population. He wisely emphasises the strength of feeling within the castes for its preservation as the fitting, and indeed to them the only possible, ordering of society which would maintain social prestige. This applies even to the Untouchables. This is an aspect of the problem upon which Mr. O'Malley, as an ex-census officer, is well qualified to speak. The advantages and disadvantages of caste as a social, political and ethical factor are balanced with judgment.

It is to be regretted that this book was not published earlier by two or three years; as it is, it will give the public a juster estimate of the difficulties which still have to be faced in India.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By Dr. J. W. Mellor. Vol. 12: *U, Mn, Ma, Re, Fe (Part 1).* Pp. xiii + 944. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 63*s*. net.

THE new volume of "Mellor" includes the elements uranium, manganese and its recently discovered homologues, and iron. The chapters dealing with the first two elements do not call for special comment, although it may be noted that triangular diagrams are used extensively to illustrate the properties of ternary alloys of manganese and that the spectrum of the element is recorded in unusual detail. It is, however, of interest to note that the homologues of manganese already occupy 17 pages, including more than 1½ pages of references, nearly all dating from 1929, when rhenium was first isolated in substantial quantities.

The chapter on iron differs from any that have appeared hitherto, in that nearly half a volume is now devoted to pure metallurgy. The compounds of iron are therefore held over to a subsequent volume. The thoroughness with which the literature has been searched is indicated by 17 pages each of references to the history of iron and to its extraction from its ores, and 30 pages of references to its occurrence. Greater interest will be found, however, in the sections on the allotropes of iron, its microstructure and crystalline form, the iron-carbon system, etc., where questions of wide general interest are discussed and illustrated with photomicrographs, equilibrium diagrams, and other figures, of which the chapter contains a total of no less than 178. Whilst, therefore, the chapter on iron will maintain (and may even enhance) the reputation of the book as an encyclopædic guide to the literature, its particular character makes it much more readable than some of the other chapters.

Théorie de la quantification dans la nouvelle mécanique. Par Prof. Louis de Broglie. Pp. xxviii + 250. (Paris: Hermann et Cie, 1932.) 70 francs.

THE attention of theoretical physicists ought to be directed to this volume, in which Prof. Louis de Broglie develops the general theory of 'quantification' and elaborates the exposition given in his "Introduction to the Study of Wave Mechanics". Instead of following the method of matrices associated with the names of Heisenberg and Born, or Dirac's method using a non-commutative algebra, he systematically proceeds from the point of view of undulatory mechanics. His treatment approaches that employed by Weyl at the beginning of his work on group theory and quantum mechanics.

The first part of the book is introductory and deals with the general principles of wave mechanics. After discussing the indispensable mathematical preliminaries he proceeds to the general theory, which leads to the prediction of the quantified values of any mechanical magnitude whatever, and the respective probabilities of these quantified values. He attaches importance to the study of the first integrals, which he regards as one of the essential parts of the new mechanics. He claims to have given a logical and consistent treatment of modern quantum theory, which appears so strange to those who are familiar only with classical conceptions.

Collected Papers of Charles Sanders Peirce. Edited by Charles Hartshorne and Paul Weiss. Vol. 1: *Principles of Philosophy.* Pp. xvi + 393. 21*s.* net. Vol. 2: *Elements of Logic.* Pp. xii + 535. 31*s.* net. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1932.)

THE authorities of Harvard University are to be congratulated for their publication of the papers and notes left by Charles Sanders Peirce. A master mind and a pioneer in philosophical inquiry, Peirce had never an occasion of publishing a standard work embodying his views. So that the editing of his papers is in itself a feat which deserves the praise and gratitude of all scholars. We would do little justice to the philosophical vision of Peirce in estimating his work on the strength of the first two volumes, out of a series of ten, which are to be published. It will suffice at present to indicate the wide range of topics touched upon in the present volumes: the method of science, the classification of the sciences, the logic of mathematics, the categories, the character of logic, speculative grammar, critical logic, and the theory of probable inference. T. G.

An Introduction to Analytical Psychotherapy. By Dr. T. A. Ross. Pp. vii + 203. (London: Edward Arnold and Co., 1932.) 10*s.* 6*d.* net.

DR. ROSS is to be congratulated on a very readable book. He gives a good account of the unconscious which he considers must be assumed to exist. Although the author, to a large extent, is a very staunch supporter of Freud, he is very honest in his appraisal of his methods, and candidly admits that suggestion must in any analysis play a very important part. This we consider very important and very true.

The author is not inclined to accept a fixed symbolism for any interpretation of dreams. He rightly points out how Freudian symbolism carried to undue limits may give interpretations which are undoubtedly false; dream interpretation is not so straightforward as some good Freudians would have us believe.

We cannot agree with the author that Adler does not appear to have made much contribution to psychotherapy. There are many who do not accept Freud or Jung, but are willing to accept Adlerian ideas.

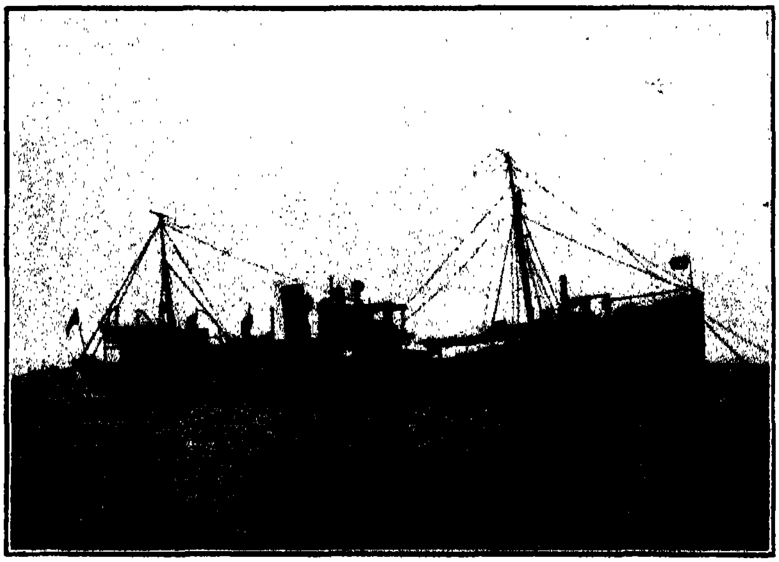
Meet the Sciences. By W. M. Malisoff. Pp. vi + 196. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1932.) 15*s.* 6*d.* net.

CLASSIFYING the sciences has been a pleasant and harmless game for the philosopher ever since the time of Plato. The complex growth of our knowledge has, however, of late discouraged amateurs of this kind of jig-saw puzzle. The trouble with it is that either the definition of any science is too wide and thus annexes foreign territory on its borders; or it is narrow and allows border provinces to be taken over by a neighbouring science. Yet, order of some kind is badly needed in the description of our present-day knowledge: this ungrateful task is courageously performed by the author of this book. The result of his efforts should be, for the scientific worker, a more tolerant understanding of his subject, and for science, a clearer conception of its humble aims and human value.

The John Murray Expedition

By PROF. J. STANLEY GARDINER, F.R.S.

THE late Sir John Murray, whose name will ever be associated with the *Challenger* Expedition, left for scientific purposes certain funds, which have been allowed to accumulate since his death. He desired that these funds should be used for a scientific expedition, a sequel to the *Challenger*, and such an expedition has now been arranged by his children, who are also his trustees. In seeking to carry out their father's intentions, they sought the advice of oceanographers of all countries as to its venue and objects. The responses were most gratifying, but many of the proposals were beyond the means at the disposal of the trustees, while others represented sections of research already in progress. All the replies were submitted to Drs. E. J. Allen and W. T. Calman, the writer acting on behalf of the trustees.



Barki, Alexandria

FIG. 1. The *Mabahiss*, for the John Murray Expedition of 1933-34.

Three practical proposals of areas for the research of an expedition emerged, namely, off the north-west coast of South America, the Indian Ocean and the Red Sea. It was felt that the last-named, an enclosed sea of more than 1,000 fathoms with a sill to the south of less than 100 fathoms, presented peculiar opportunities for intensive and continued research, but that this should be based on Ghardaga, the newly erected Egyptian marine station off the Gulf of Suez, rather than attacked by an isolated expedition. In all three seas, a knowledge of the bottom fauna and conditions was emphasised. In addition, the two oceans present problems of oceanic circulation of considerable complexity and of wide interest.

On consideration and inquiry, the difficulties of arranging a west American expedition proved insuperable, so that the referee's choice fell on the Indian Ocean, which had been suggested in several memoranda. One of the latter had been presented by Col. Seymour Sewell, director of the Indian Zoological Survey and formerly surgeon-naturalist on the *Investigator*, and he was invited to lead the expedition. The further plans have been worked out by a committee including representatives of the Admiralty, the British Museum, the Royal Society and the trustees of Sir John Murray, in co-operation with Col. Sewell. The Committee consists of Mr. J. C. Murray (chairman and treasurer), Vice-Admiral Sir H. P. Douglas, Capt. J. A. Edgell (hydrographer to the Admiralty), Dr. C. Tate Regan (British Museum), Prof. G. I. Taylor (Royal Society), Drs. E. J. Allen, W. T. Calman and Stanley Kemp and Prof. J. Stanley Gardiner (secretary).*

It would have gratified Sir John Murray to know that the Indian Ocean has been selected, since this ocean was deliberately omitted from the route of H.M.S. *Challenger*, the Indian Government having undertaken to carry out its exploration. The whole area proved too large for the elaborate and detailed research demanded to-day, so that the operations of the expedition are to be confined to the Arabian Sea, which is bounded to the south-east by the Maldive and Chagos ridge and to the south by the latitude which passes through the Seychelles. This area feeds the Red Sea to the north-west and the shallow Persian Gulf to the north, and its conditions to some degree are simplified by its continuous land-boundary to the north and east. Its deep sea life has never been collected save by the I.M.S. *Investigator* and then only by spasmodic observations and a few trawlings near the Indian coast. The *Valdivia* traversed the southern part of the area on her great cruise and the *Dana* crossed it on her way home. Lately, the Admiralty has taken serial water samples in and off the Gulf of Aden, and much attention has been paid for many years to the water movements by the Marine Division of the Meteorological Office. H.M.S. *Sealark* spent the season of 1905–6 amongst the islands and submerged banks to the south, visiting in turn the Chagos Archipelago, Mauritius and Seychelles, besides most of the smaller islands and banks. Her investigations were mainly concerned with coral formations, their growth and decay, the deep sea being studied mainly by soundings. Even to-day, except on certain steamer routes, the depths are little known. The greatest charted is 2,930 fathoms, and the average depth about 2,500 fathoms, with openings to the south of 2,000 fathoms between Seychelles and Chagos and perhaps between Chagos and Maldives. With this topography the question of water circulation from the surface to the bottom is naturally a subject of particular interest.

Great difficulty was experienced in obtaining a suitable ship of the trawler type for the expedition. Any vessel would have to be fitted with sonic sounding apparatus and few proved to be suitable. The best available vessel appeared to be the *Mabahiss*, which was built for scientific work by the Egyptian Government in 1929. The Committee placed its dilemma before Egypt, King Fuad being well known for his interest in oceanography, and at the same time pointing out the desirability of an Egyptian scientific expedition down the Red Sea. In reply the Egyptian Government most generously proffered the loan of the *Mabahiss* for the winter of 1933–34, the Committee to equip her with echo and other necessary scientific gear. This friendly action will be most deeply appreciated by science, the international appeal of which is thus recognised.

A further plan is to use the *Mabahiss* in 1934–35 for an Egyptian exploration of the Red Sea, the same scientific methods to be followed in both expeditions so that results will be strictly comparable. The Red Sea expedition will give a worthy start to the Ghardaga Marine Laboratory of the University of Cairo, which, possessing deep water and tropical conditions in its immediate vicinity and being of easy access from Europe, bids fair to become of great value to science.

According to the present plans, the *Mabahiss* will be commissioned at Alexandria and sail on September 1. She will be commanded by Capt. Mackenzie, formerly of the S.S. *Discovery*. Lieut.-Commdr. Farquharson, who has been seconded for the expedition, is to take charge of the echo sounding and other survey work. On his side, Col. Sewell will be accompanied by four biologists, two of whom will specialise on the physico-chemical side and two on the ecological. The officers and crew will be Egyptian, and there will be two research students from the University of Cairo. After anchoring for a night at Ghardaga, the *Mabahiss* will run a depth section down the Red Sea to the Gulf of Aden, where several weeks will be occupied in the investigations of its depths, bottom fauna and circulation. While a continuous graph of the surface temperature will be taken on board the *Mabahiss*, the surface water samples, collected not only by the *Mabahiss* but also by certain liners, will be sent to the University of Cairo for analyses. The deeper water layers, however, will be investigated on board the *Mabahiss* by rapid methods, and it is hoped that thereby estimations of hydrogen ion concentration, oxygen, phosphates, nitrogen compounds and silica or some of these may be so quickly available that they will be of help in the planning of future work.

So soon as the north-east monsoon has become established, the *Mabahiss* will proceed to run a series of parallel lines of soundings between India and Ceylon and the African coast, unless the results obtained determine otherwise. In any event, there will be a special cruise in the Gulf of Oman for comparison of its conditions with those of the Gulf of Aden, and this will be followed by a cruise down the Maldives, where Major Glennie of the Indian Survey will take a series of pendulum observations across the bank with the object of determining the depth of the foundations on which its coral reefs are built. On all cruises, stations will be established at intervals for serial temperature observations and to obtain water samples from the surface to the bottom. In certain regions, the deposits should be of particular interest, and they will be collected by sounding leads and conical dredges. It is suggested that the blue mud off South Arabia may well be of especial interest, as also the green sand (glauconite), which in places is found from 50 fathoms to more than 1,000 fathoms, and the conditions of formation of which are uncertain.

The investigation of the deep sea biology, to the understanding of which all observations, physical, chemical and topographical, will be applied, is to be especially concentrated in the Gulfs of Aden and Oman and off the East African coast. Otter and Agassiz trawls and dredges of standard sizes will be regularly employed down to 1,000 fathoms, as well as the Petersen grab. Quantitative estimations of the bottom may not be possible, but it is hoped that the fauna will be adequately represented in collections and to a considerable degree determined in depth zones. The 'mud line' at about 100 fathoms, so named by Sir John Murray, is of especial interest off the Arabian coast, which, in spite of a high water temperature and an apparently suitable topography, is almost devoid of coral reefs. In connexion therewith, the shallower coastal waters may be investigated, a motor launch being carried for this work. It is hoped also that transparency observations may be possible. Plankton as such is not an object of study since the collections obtained by the *Discovery*, *Dana* and other vessels are sufficient to tax the energies of systematic workers for twenty to fifty years. On the *Mabahiss* it will be collected mainly in connexion with the investigation of the water layers and movements, but mid-water nets will be employed for the examination of the fish and other swimming life.

It is impossible to lay down beforehand detailed plans of the John Murray expedition or indeed of any future marine exploratory expedition. The coming of echo sounding allowing all depths to be read as a ship proceeds on her course, the determination of temperature sections and the invention of rapid chemical methods to be applied on ship-board to water samples from the surface to the sea floor, have altered the planning of all future marine expeditions, the course of which will undoubtedly be determined by the results obtained.

The Contribution of Radiotelegraphy to Geophysics

On Thursday, April 27, the Kelvin lecture was delivered before the Institution of Electrical Engineers by Sir Frank Smith, who took as his subject, "The Travel of Wireless Waves". In the course of it, an interesting picture was presented of the position attained by modern research, both theoretical and experimental, on the mode of propagation of the electric waves employed in radio communication. Particular reference was made to the bearing of the results of this work on the general problems encountered in geophysics, and the manner in which modern research has provided the radio-geophysicist with an invaluable tool with which to probe into the higher reaches of the atmosphere.

The appropriateness of this lecture was expressed in the observation that Lord Kelvin first studied the oscillatory discharge of a condenser, and read a remarkable paper on it exactly eighty years ago. Kelvin also introduced a tool known as the 'image method', applicable to many problems of physics; and when this is applied to Hertz's dipole oscillator, the familiar pattern is obtained of the electric field due to an oscillating charge over a perfectly conducting plane. The energy radiated from such an oscillating dipole is in the form of electromagnetic waves, the properties of which are identical with light waves, due allowance being made for the difference in wave-length. The waves will travel in straight lines except for such deviation as will occur due to refraction or diffraction effects.

When Marconi successfully demonstrated the transmission of wireless signals around considerable portions of the earth's surface, much attention was directed to the problem of the manner in which the necessary deviation was produced. Fleming showed that refraction due to the variation of atmospheric density with altitude would produce a negligible effect, while similar conclusions were reached in a study of the diffraction effects, even making allowance for the conductivity of the earth and the resulting currents set up by the waves passing over it. Moreover, G. N. Watson found that in the case of diffraction the factor showing the dependence of the effect upon wave-length was of a different power from that obtained empirically and embodied in the well-known Austin-Cohen formula. The experimental investigations also produced later some remarkable results, such as the striking differences between day and night transmissions, and the unexpected potentialities of the shorter wave-lengths for long distance communication, in spite of their well-known rapid absorption by the earth.

The need for a 'deflecting' region in the upper atmosphere was recognised in a note published by Prof. A. E. Kennelly in March 1902. A similar suggestion was made by Heaviside in an article written in June of the same year and afterwards published in the "Encyclopædia Britannica". In 1912, W. H. Eccles directed attention to the possible influence of the ionisation of the upper atmosphere on the propagation of electromagnetic waves through it, and to the resulting differences in day and night transmission. A few years later, Watson overcame his previous difficulty in a calculation of the field intensity of a wave propagated in the space between the earth and a conducting shell concentric with it.

In such circumstances it is natural to find the radio worker turning to the geophysicist for some knowledge of the properties of the atmosphere. By the aid of direct measuring instruments, the geophysicist has learnt much of the detailed physics of the troposphere and lower portions of the stratosphere; but it is not until a height of about 50 km. is reached that much information of direct interest to the radiotelegraphist is supplied. At this height ozone is found as the result of the dissociation of oxygen by ultra-violet light, and this action is accompanied by ionisation, which naturally suffers a rapid reduction after sunset as a result of recombination. Further information on such ionisation in the higher regions of the atmosphere has been obtained from the study of aurora and also from investigations in terrestrial magnetism; and attention may be directed to the fact that Balfour Stewart in 1878 was the first to suggest that the daily changes in intensity of the earth's magnetic field are due to electric currents in the conducting portions of the upper atmosphere.

As a result of all this work, the radio investigator is informed that there exists, concentric with the earth, a spherical conducting layer, that the conductivity is due to electrons or ions, and that the conductivity varies with the direction so that electric waves penetrating the layer will be polarised. The probable ionising agents are ultra-violet light and charged or neutral particles projected from the sun, so that the layer is likely to be much more highly conducting on the side of the earth exposed to the sun than on the side in darkness. On this geophysicist's picture of the ionosphere no accurate scale of heights can be placed, nor can values of the ionisation density be assigned. It is merely known that the ozone is most dense at about 40 km., and that the electron streams produce aurora at heights of from 90 km. to above 500 km.

With all this information at his disposal, the radiotelegraphist has been able to obtain at least a qualitative explanation of many of the phenomena encountered in his experimental investigations of the results of emitting waves from a radio station. In the first place, it is clear that, so far as the waves sent along the ground are concerned, the distance to which they travel before their field intensity falls to some specified value increases as the wave-length is increased; and for this reason moderately long waves of wave-length 200 to 2,000 metres are employed for general broadcasting services. Next, the portion of the waves which are sent into the upper atmosphere will be refracted on entering the ionised portions and, upon reaching a height at which the density of ionisation is sufficiently great, the deviation will be such as to return the waves to the earth's surface. It has been found that on a wave-length of about 50 metres and using an antenna power of 5 kilowatts, these waves returning from the ionosphere reach the earth and affect a receiver at a minimum distance of the order of 2,500 miles. Since under the same conditions the ground wave will only be detectable at distances up to about 90 miles, there will be an annular space around the emitting station having inner and outer radii of 90 miles and 2,500 miles respectively in which no signals will be detectable. This is commonly known in radio engineering circles as the 'skip' effect and the larger radius above is termed the 'skipped distance'. As the wave-length is increased, this distance decreases steadily owing to the greater refraction effects taking place in the upper atmosphere; at the same time the range of the ground wave increases, and finally the two overlap for wave-lengths approximately in the shorter broadcasting band of 200 metres to 500 metres. Under these conditions, both ground and atmospheric waves reach the receiving station, and it is the interference effects resulting from these two sets of waves which cause the well-known phenomena of fading in broadcast reception, and of the variation of bearing in radio direction-finding.

In the later portion of his lecture, Sir Frank Smith described how the radio investigator has recently directed his attention to obtaining more conclusive proofs of the existence of the ionosphere and to the quantitative measurement of its properties; that is, to obtain information which the geophysicist has been unable to supply. Methods employed in other branches of physics have been adapted to radio communication for this purpose. One of these makes use of the interference effects obtained between the ground and atmospheric waves to determine the height of the ionosphere. The same objective has also been attained by using an echo method to measure the time taken by a pulse of electric waves to travel up to the ionised deflecting layer and return to earth. Owing to the very high velocity of the waves, this time interval is short—about one-thousandth of a second—and the cathode ray oscillograph has proved an invaluable tool in the determination of this quantity.

Working in this manner, the radiotelegraphist has conclusively proved the existence of the Kennelly-Heaviside layer in the ionosphere at an average height of about 100 km. The measurements showed that for most nights the height of this ionised layer gradually increases, a maximum value being reached about one hour before sunrise. Further investigation showed that on certain occasions and with wave-lengths less than 400 metres, the height of the deflecting layer suddenly changes from 100 km. to about 230 km. It then became evident that on such occasions the density of ionisation in the Kennelly-Heaviside layer is insufficient for the deflection of the shorter waves, which thus penetrated this layer, but are ultimately deflected by a second layer above the first, the existence of which had not previously been suspected. This upper layer has been named after Prof. E. V. Appleton, who, with the co-operation of the Radio Research Board, has played the leading part in Great Britain in the investigations just described.

Having fixed the heights of these two important regions of the atmosphere, it has next been found possible to determine the density of the ionisation in these regions by ascertaining the limiting wave-length or frequency of the waves which will just penetrate the layer. Experiments carried out in this manner have shown that the ionisation is at its maximum about noon and decreases steadily as sunset is approached. After sunset, a rapid fall in ionisation takes place until, at about two hours afterwards, its value is only about one-tenth of the maximum, and this then remains reasonably constant until shortly before sunrise. Two further facts which emerge from the work are that there is very little ionisation between the Kennelly-Heaviside and the Appleton layers, and that, for wave-lengths less than about 8 metres, the waves penetrate both layers and there is as yet no evidence of their return to earth from the upper atmosphere. As to the cause of the ionisation, some data obtained during the solar eclipse of August 31, 1932 appear to establish the fact that the principal ionising agent for the two layers is ultra-violet light. The possible bombardment of the earth by neutral particles is not yet wholly excluded, but undoubtedly the evidence so far is against it.

The review provided in this lecture shows very clearly that the modern radio research worker is obtaining detailed quantitative knowledge of certain portions of the atmosphere in a manner which was beyond the reach of the former geophysical methods of attack.

Hydrogenated Motor Lubricants

THE recent display of advertisements has directed public attention to a new oil, "Essolube", a product representing the much-discussed process of hydrogenation successfully applied to the refining of petroleum. This particular lubricating oil is the product of many years research, involving much expenditure and the laying down of large-scale plant. The entry of hydrogenation as an established commercial process in the oil industry is an event of first-class technical and economic importance, and in many respects it will be a surprise to most people that the first satisfactory synthetic product in this field is a lubricant, a class of material distinguished for its extreme variability and one of the most sensitive (in performance) of the whole range of petroleum distillates.

Broadly speaking, it is demanded that a high-quality lubricating oil should possess a good viscosity index, a low pour point, a wide range of stability, high flash point and low carbon value; these properties are claimed as entirely characteristic of the synthetic product. A good viscosity implies an oil which changes least in characteristics with temperature range, making for easy starting of an engine in cold weather, reducing wear of the moving parts and, at the same time, ensuring that under operating conditions an adequate oil film is preserved round the piston; these factors naturally affect the question of oil consumption. The essence of stability is the ability of the oil to preserve its fundamental characteristics in performance, and the lack of tendency to form sludge or to coagulate in any manner which might tend to choke the lubricating system. The low carbon value is sought for many reasons; chiefly to take care that, whatever carbon is formed, is of a soft and non-crystalline character, as hard carbon particles returned to the oil sump will inevitably act as an abrasive and do damage to the vital parts of the engine.

Production of modern lubricating oils is, quite apart from this new process, a highly specialised subject, concerning which much still remains to be, and is being, done in the matter of fundamental research. Possibilities of hydrogenation as applied to petroleum products have of course been long foreseen by technologists both in Great Britain and in America, but the advent of a marketable product at this juncture is certainly a most commendable departure.

An account of this enterprising action of the Anglo-American Oil Co., the concern responsible for the introduction of this new lubricating oil, appears in the *Times* of April 29. Concurrently with the appearance of this product, the same Company is responsible for introducing a new method of delivery of the oil to motor engines. Supplies will be fed directly to the engine from sealed glass bottles and the displacing of the familiar tin will be an advantage in many ways since, apart from guaranteed measure, the contents can be seen and, incidentally, the shape of the bottle is such that it can be easily inverted into the oil filler of the engine, thus obviating loss by spilling, especially where such fillers are placed in awkward positions.

It is of interest to note the Company's exhibition of hydrogenation at Charing Cross Underground Station, a place, incidentally, one now instinctively associates with modern commercial enterprise in educating the public to at least some visual knowledge of commodities in everyday use which, in a vast majority of cases, are taken very much for granted. So much has been heard of, and written about, hydrogenation in the last few years without, to the lay mind, as yet any tangible expression, that the coincidence of a new synthetic hydrocarbon and the display of technique and issues involved, will do much to awaken interest in the untiring service that science renders to the community to-day.

Lessons in Visualisation from the Royal Academy

By Dr. Vaughan Cornish

SCENERY is defined as the appearance of a place from the picturesque point of view, and so, without pausing to consider what constitutes picturesqueness, we may note at once that scenery is an appearance. The science of scenery is, therefore, a science of appearances, and consequently the question whether a landscape painting is true to the facts can only be answered if we know how the physical surroundings are pictured through the agency of the eye.

There are three very different modes of picturing landscape; by the camera, by the representational school of painting, and by the imaginative school. Leaving the discussion of the last category for another occasion, let us now compare the rendering of the facts of scenery by the camera and by the school of painting hitherto dominant at the Royal Academy.

Even within the limits of monochrome, to which the camera is usually restricted, a clear photograph of a well-lit landscape is radically different from the natural picture. Not only the eye of the artist but also that of the ordinary man is selective. The natural picture of the landscape is not the sum of those features which we can see when we examine bit by bit the whole field of outlook, but a *composition* formed of that which we notice spontaneously. It may even be that in scenes which stir the emotions deeply, the proportion that remains unnoticed, that is to say mentally invisible, is greatest.

Largely on account of this selective action of the eye, and not merely on account of the vagueness of the image near the edge of the retina, the skilful composition of the landscape painter is in some important respects nearer than the photograph to the facts of scenery. It may be suggested in passing that the customary preference of the landscape artist for painting largely from memory, is not only on account of the troublesome variation of light in the actual scene, but also because memory is selective, and its partialities help to obliterate the inessential from the mental picture.

As an example of truth to Nature (in the wider sense) as exemplified in the school of landscape painting usually dominant at the Royal Academy, I may cite "The Shores of Clyde" (340) by

Mr. Robert Houston. This is an entrancing picture of sea and sunshine, flowering gorse and sheep grazing, cottages of fisher folk by the shore (at the foot of the hill from which the scene is viewed), a rocky islet catching the light, and in the distance a range of mountain peaks suffused with the tranquil, atmospheric blue. A few clouds are floating high, and from above the field of sight, the sun streams down, casting a broad lane of light upon the rippling summer sea. It all seems so natural, and exactly as we recall the scenery of Scotland in its happiest mood. The descriptive title of the picture does not tie us to a particular view-point, and this is fortunate for the average man, who is apt to feel that some deception has been practised when he finds the natural features arranged otherwise than as he is accustomed to see them from a specified view-point. In this connexion it is well that scientific people should recall the fact that mathematicians exercise a license somewhat similar to that of the artist in the generalisation of geophysical facts. The tidal bore in the River Severn, for example, does not always conform to the type of wave to which mathematicians restrict the name, although the mathematical conception was largely based upon this local example.

The water-colour "Gate Crag, Grange, Westmoreland" (1039) by Mr. Harold Gresley, has a definitely locative title, but as I am not acquainted with the particular spot the question of composition does not obtrude, and I simply welcome a delightful rendering of the charm of the English Lakeland. A single-arched bridge spans a rapid stream beside which stand the simple, whitewashed houses that Wordsworth loved. The foliage of pleasant round-topped trees diversifies the vale, and in the background the steep fell-side stands in shadow, with white clouds half uncovered, half hidden by the rugged mountain crest.

The sympathetic rendering of such scenes is always welcome, but it must be confessed that our painters have been less alert than the cameramen in availing themselves of modern facilities of transport for extending their range of subjects. Such pictures as that by Mr. Norman Wilkinson ("Territorials", 385) are as welcome as they are rare. The view, from an aeroplane, is of companion aeroplanes, backed by the piled domes of massive cumulus revealed in all their grandeur from a more advantageous point of sight than the ground provides.

When the man of science goes to the Royal Academy to learn what he can from the artist, it is well that he should not confine his attention to landscape, for pictures of interiors also convey lessons in visualisation. That of "The Library, Eaton Hall" (235), by Mr. Frederick W. Elwell shows a long gallery with the amplitude of dimension relatively to the human figure which is an outstanding advantage of the great country mansion. The perspective of such an interior satisfies certain faculties of the eye for which the natural landscape does not provide appropriate exercise. Moreover, the appointments of the room illustrate the fact that a well-furnished interior can provide more satisfaction for the eye in respect to diversities of texture than any natural scene. Here we have, skilfully painted, the glaze of pottery and porcelain, the glint of metal, the lustrous reflexion and transmission of glass vessels, and the polish of fine wood-work. Rich and varied as are these textures, it is the vase of flowers which brings the ultimate refinement of texture to the furnished interior.

Obituary

SIR JIVANJI MODI, C.I.E.

WE regret to record the death at Bombay of Sir Jivanji Jamshedji Modi, the widely-known and highly esteemed Orientalist, on March 28, aged seventy-two years. He was born on October 26, 1854, the son of the head priest of the Parsee Fire Temple at Colaba on the island of Bombay, and was educated at Elphinstone School and College. The studies to which he gave special attention, and in which he won a world-wide recognition as the foremost authority, were the origins, literature and teaching of Zoroastrianism, as well as the history of the Parsee community. For many years he was the secretary of the Parsee Panchayat in Bombay. He was one of the most active members of the Bombay Branch of the Royal Asiatic Society, which recognised his services to Oriental studies by the award of the Campbell medal in 1918. He was prominent in promoting the Oriental Research Institute at Poonah in memory of his friend, Sir Ramkrishna Bhandarkar, and did much work in connexion with the Cama Oriental Institute.

Sir Jivanji Modi's very considerable published contributions to scholarship for the most part appeared in the form of monographs, which were afterwards collected and republished in volumes such as his "Asiatic Papers", in four parts, "Anthropological Papers", also in four parts, "Memorial Papers", "Dante Papers", etc. He also wrote a history of the Parsees and published a number of translations from the Pahlavi.

His learning was widely recognised in both India and Europe; although it may be said without detraction from his scholarship that his commanding position in the world of Oriental studies was in some degree enhanced by his singleness of purpose and charm of character, which won the admiration and affectionate respect of all with whom he came into contact. He had long been a fellow of the University of Bombay, which conferred on him the degree of LL.D. in 1930. The Government of India made him an honorary correspondent of the Archæological Society in 1914 and conferred on him the title of Shams-ul-ulama. He was made a C.I.E. in 1917 and knighted in 1930. He was one of the few honorary members of the Royal Asiatic Society, an Officier d'Académie and Chevalier of the Legion of Honour.

WE regret to announce the following deaths :

Commdr. W. M. Carey, R.N.(retd.), captain of the R.R.S. *Discovery II*, which has just completed its second cruise, during which the Antarctic Continent was circumnavigated, on May 2, aged forty-six years.

Prof. R. E. Jeffs, associate professor of botany in the University of Oklahoma, known for his work on plant physiology, on February 11, aged fifty-three years.

Prof. Jules Piccard, formerly professor of chemistry at the University of Basle, aged ninety-three years.

Sir Arthur Whitelegge, K.C.B., chief inspector of factories from 1896 until 1917, author of "A Manual of Hygiene and Public Health", on April 25, aged eighty years.

Mr. E. B. Williamson, formerly assistant curator at the Carnegie Museum, and since 1930 research associate in the Museum of Zoology of the University of Michigan, who was an authority on dragon-flies, on February 28, aged fifty-five years.

News and Views

Portraits at the Royal Academy

IN addition to the pictures at the Royal Academy mentioned by Dr. Vaughan Cornish in his article elsewhere in this issue, scientific workers will be interested in the following portraits: Prof. S. Alexander, honorary professor of philosophy in the University of Manchester, charcoal, by Francis Dodd (1212); Sir Richard Glazebrook, formerly director of the National Physical Laboratory, by Edward I. Halliday (390); Dr. George Francis Hill, director and principal librarian of the British Museum, bronze medallion by Frank Bowcher (1650); Prof. J. G. Lawn, mining engineer, director of and consulting engineer in England to the Johannesburg Consolidated Investment Co., Ltd., bronze bust by Maggie Mitchell (1736); Dr. Eleanor Lodge, formerly principal of Westfield College, London, by Gerald F. Kelly (91); Sir Murdoch Macdonald, president of the Institution of Civil Engineers, bronze bust by Gladys Barron (1725); Lord Melchett, director of Imperial Chemical Industries, Ltd., by Glyn Philpot (274); Dr. Alexander Scott, director of scientific research at the British Museum, head by Sir W. Reynolds-Stephens (1638); the late Sir William Smith, founder of the Royal Institute of Public Health, bust by Charles L. Hartwell (1602); and Sir J. J. Thomson, master of Trinity College, Cambridge, chalk, by W. T. Monnington (1180). Among the other exhibits are a tempera of the foundations of the new Geological Museum, South Kensington, by Laurence Wheatley (881); while the architectural drawings and models section includes the library of the same Museum, by John H. Markham (1405), proposed additions to the Ashmolean Museum, Oxford, by Stanley Hall, and Easton and Robertson (1400), the completion of wings to Gower Street of University College, London, by Richardson and Gill (1512); and an etching and dry point of Battersea Power Station, by H. R. Myerscough-Walker (1257).

New Gorilla House at the Zoological Gardens

THE new Gorilla House at the Gardens of the Zoological Society of London was opened on Friday, April 28. Sir Peter Chalmers Mitchell, in a short but admirable speech, traced the origin and the merits of the new house, which are many; indeed, there is no other like it in Europe. Having regard to the rarity of gorillas in captivity, and their frailty, it was felt that an entirely new method of housing them should be devised. The general plan of the house was conceived by Sir Peter, but its elaboration was entrusted to Mr. B. Lubetkin, of Messrs. Tecton Ltd., architects. Briefly, it forms a large, circular chamber divided into two equal portions, a winter and a summer house. In the winter, the public have access in the half set aside for summer, and they are shut off from the animals by a glass screen to eliminate the danger of infection from influenza by the public. The air in this enclosure is filtered, warmed, and moistened, before passing into the chamber, which is free from draughts. Here we saw the two gorillas which the Society has now had since last August in a particularly frolicsome mood, due no doubt to the ample proportions of their apartment. In the summer the semicircular wall and roof of iron which forms the winter "Hall of Audience", is caused, by machinery, to pass behind the winter house, leaving it fully exposed to the sun and air, and enclosed only by strong bars. The glass partition is also withdrawn, leaving a great circular space wherein the animals may furnish their visitors, now standing outside, with opportunities for studying the habits and movements, of these, the largest and most powerful of all the great apes.

New Autogiro

A NEW model of Senor de la Cierva's autogiro, incorporating a radical alteration in the method of control, was demonstrated by the inventor at the London Airport, Hanworth, on April 27. The autogiro derives its lift from a number of blades rotating in a horizontal plane, instead of fixed wings as in a normal aeroplane. Thus there is relative motion between the blades and the air, with consequent lift, even when the machine has little or no forward speed. The autogiro can therefore fly with little speed relative to the earth, and can land and take off almost vertically. Hitherto, the orientation of the machine when airborne has been governed by the orthodox aeroplane aileron, elevator and rudder for lateral, horizontal, and directional control respectively. This new model, Type C.30, replaces all of these controls by altering the direction of the resultant lift of the rotors by tilting their supporting pillar. A lever attached to this column is pulled back to make the nose rise, forward to drop, sideways to turn and bank correctly at the same time. Thus the pilot's task in the air is considerably simplified, although apparently at the expense of a certain amount of rapidity in manœuvrability. Another advantage of this new control is that its effectiveness is a function of the speed of the rotating blades, and not of the forward speed of the machine as in the normal aircraft. It is therefore equally effective at low flying speeds, a particularly important point in landing, taking off, and flying near the ground generally. The absence of the usual control surfaces and their supporting parts should give a considerable saving in both weight and head resistance, and should simplify construction. A fixed tail plane and a vertical fin are still retained for stability, and a tail wheel controlled by an orthodox rudder bar is used for turning on the ground.

Royal Institution

THE annual meeting of the members of the Royal Institution was held on May 1, the president, Lord Eustace Percy, being in the chair. The annual report of the Visitors for the year ended December 31, 1932, testified to a year of considerable activity. The membership had been well maintained. The privilege of free attendance at the afternoon lectures by *bona fide* students in London had been much appreciated and used. The report on the progress of the researches in the Davy Faraday Laboratory gave a good indication of the considerable extent of the research organisation which is at work under the direction of Sir William Bragg. Some sixteen or eighteen workers are engaged, the majority on problems related to the X-ray determination of structure. Mention was made of Dr. J. M. Robertson's determination of the structure of anthracene, of Dr. A. Müller's work on the long-chain compounds, and of the growth in accuracy and capacity of the large experimental X-ray plant in the hands of Dr. Müller and Mr. R. S. Clay. The capacity of the apparatus is calculated to be about 50 kw.; as yet it has worked well up to 10 kw. The treasurer's report and accounts showed a very satisfactory position, in spite of the heavy demand on the financial resources of the Institution caused by the recent reconstruction. After a total expenditure in connexion with the rebuilding of more than £100,000, a diminution in the invested funds of the Royal Institution of about £2,000 is shown. This gratifying result is a consequence of many generous donations to the Building and Research Endowment Fund raised by the Institution in the past three years. The donations and other receipts to this fund have been sufficient to defray almost the entire cost of the rebuilding, and to go a considerable way towards completion of the programme of permanent endowment of research which the Managers of the Institution have as one of their principal objects. The following officers for 1933–34 were elected: *President*, the Right Hon. Lord Eustace Percy; *Treasurer*, Sir Robert Robertson; *Secretary*, Major Charles E. S. Phillips.

Portrait of Sir William Bragg, K.B.E., O.M., F.R.S.

AFTER the formal business of the annual meeting of the members of the Royal Institution, a portrait of Sir William Bragg, painted by Mr. William Nicholson, was presented to the Institution, on behalf of a group of subscribers, by the honorary secretary, Major Charles E. S. Phillips, who expressed the gratification of the donors at having secured the help of so distinguished an artist. Mr. Nicholson had given them, he said, not only a good portrait of Sir William, but also a very fine painting. Major Phillips went on to pay a tribute of admiration for the work of Sir William Bragg and to speak of the affection in which he is held by the members and all others with whom he comes into contact in his work. The portrait was accepted by the president, who thanked Major Phillips for having taken the initiative in regard to its painting and presentation, resulting in a valuable acquisition to the permanent treasures of the Institution. Sir William Bragg spoke briefly of his own pleasure at the expressions of goodwill with which the presentation had been made, and said that the success of the work of the Royal Institution was largely due to the friendship and devotion of its members, who had always responded freely to any request for services or appeal for help.

Centenary of Hancock's Steam Omnibus

To commemorate the centenary of the inauguration of the first power-driven omnibus in London, a joint meeting of the Newcomen Society and the Omnibus Society was held at the Institute of Marine Engineers on April 27 at which papers were read by Mr. C. E. Lee and Mr. C. F. D. Marshall. Mr. Lee said that the three principal pioneers of the steam omnibus were Goldsworthy Gurney (1793–1875), Walter Hancock (1799–1852) and John Scott Russell (1808–1882), of whom Hancock was the most successful. A watchmaker by trade, Hancock patented a very ingenious type of boiler and then built two steam carriages, the second of which, called the *Infant*, in February, 1831, began running between Stratford and London. Two years later, the London and Paddington Steam-Carriage Co. was formed and for this Hancock built the omnibus *Enterprise* with accommodation for fourteen passengers. This vehicle began running between Moorgate and Paddington on April 22, 1833, and was the first mechanically propelled vehicle specially designed for omnibus work ever to be placed in service. The route covered was about ten miles and the distance was performed in about fifty minutes. The service was worked for 16 days only, under the superintendence of Hancock, and was then withdrawn owing to differences between him and the Company. Three years later, after other experimental work, Hancock had other steam vehicles at work and in the course of twenty weeks these ran 4,200 miles and carried 12,761 passengers. Both the papers contained much information on the construction of these and other early steam omnibuses and it cannot be doubted that if the inventions had been fostered, instead of hindered, by legislation, the steam vehicle would have been brought to a high degree of perfection at an early date.

Observational and Theoretical Astronomy

ON April 28, Prof. H. H. Plaskett delivered his inaugural lecture as Savilian professor of astronomy at Oxford. Recalling the fact that the year of the foundation of the professorship was also that of the publication of Kepler's three laws of planetary motion, and directing attention to the injunction of Sir Henry Savile that the holder of his professorship should occupy himself with "observation by day and night", he remarked that three hundred years ago the observational method in astronomy might be said to have reached its zenith. Since then, the constantly increasing importance of the theoretical method has been abundantly shown; as, for example, in the discovery of Neptune by calculation and in the present conclusions as to the physical conditions in the interior of stars. Nevertheless, the achievements of theoretical astronomy still rest in part on an observational basis. This is shown by consideration of the means by which knowledge of the spatial distribution of the stars has been gained by the work of Herschel and Shapley, and of that of their physical constitution by the work of Lockyer, Franklin and Hertzsprung. It would be fair to say, looking forward to the next three or four hundred years, that it will be allowed that, so far, observation and theory have gone along hand in hand. In a more distant future it may not be so. At present, theory has played its part in the refinement of observation, but some of the results of theory must for ever be removed from observational control. But just as the explorer of the earth's surface suggests to the geographer plans for further fruitful exploration, so the astronomer going to Nature with a definite theory may succeed in getting an answer. Finally, there can be no doubt that a great university should have an observatory as part of its equipment; but it must be recognised that the part of astronomy under these conditions necessarily has its limitations.

Lachish

EXCAVATIONS at Tell Duweir in Palestine, where the Wellcome Historical Museum Expedition has been at work under Mr. J. L. Starkey, have now closed for the season. The particular interest of this excavation lies in the possibility that the site may be the city of Lachish which was captured by Joshua after a stout resistance. So far, nothing has been found to contradict this tentative identification, while some of the evidence from this season's work tends to confirm it. Lachish was captured by Sennacherib in 701 B.C.—this siege is represented on bas-reliefs from Nineveh now in the British Museum—and by Nebuchadnezzar in 586 B.C. Tell Duweir, which is situated about twenty-five miles south-west of Jerusalem at a height of 900 ft. above sea-level, dominating the Philistine country, is a mound of some forty acres in extent, tapering to eighteen acres at the summit. The stone walls identified with the city of Rehoboam show the breaches made by Sennacherib's army and traces of the conflagration by which they were made to collapse under Nebuchadnezzar. Under the stone walls of Rehoboam's city were found the red brick walls which are identified with the city of Joshua's day. A further piece of evidence pointing in the direction of the identification is the find of a metal helmet crest which corresponds with the crests on the peculiarly shaped helmets of some of Sennacherib's soldiers shown on the British Museum bas-reliefs. Part of a royal palace on the summit of the mound was uncovered, and a number of graves at the base belonging to all ages were examined and yielded a large number of skulls in excellent preservation. Objects from Tell Duweir will be on exhibition at the Wellcome Historical Museum, Euston Road, London, N.W.1, on their early arrival in England.

National Research Council of Canada

THE National Research Council of Canada has issued a statement covering its sixteen years work which indicates a close parallel between the activities of this Council and those of the Department of Scientific and Industrial Research in Great Britain. In addition to the direction of a wide range of investigations in a National Research Laboratories system, the development of a national library of science, and the publication of a *Canadian Journal of Research*, the Council has developed co-operation in research throughout Canada, instituted a policy of grants to individual research workers, and assisted in the training of scientific personnel by the award of scholarships to selected students and graduates. Its efforts have raised the whole standard of research in Canada and in addition the National Research Council has already proved its value in the day-to-day problems of government and to various State departments. During the sixteen years of its existence, the Council has paid a total of 527,951,000 dollars in research scholarships and 131,801,292 dollars in grants for research. More than half of the total expenditure has been incurred on the building and organisation of the National Research Laboratories, which were formally opened on August 10, 1932, and have already made notable contributions to scientific knowledge and industrial development.

FROM a summarised account of these activities occupying nearly fifty pages, it is only possible to select a few points as illustrations. Important contributions to the asbestos industry have been rendered by investigations on asbestos cements and the standardisation of testing and methods. Studies of the resistance of concrete structures, the development of a highly resistant cement, of the treatment and disposal of sulphur dioxide fumes from smelter stacks, waste gas and bitumen utilisation, on the prevention of rust on wheat and other cereals and on weed killing, have already proved of great economic advantage to the whole country as well as to the particular industries. There is scarcely one of Canada's wide range of interests—agriculture, mineral industries, transport, fisheries, building, fruit growing, coal, leather, wool—to which the Laboratories are not offering direct service. Highly important work has already been carried out on rubber and extensive facilities have been provided for standardising and testing all classes of materials.

Metropolitan-Vickers Research and Testing Departments

A BOOKLET which has just been issued, describing the Research and Testing Departments of the Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, shows what an important part industrial research plays in the advancement of science. The somewhat fragile and makeshift construction of the equipment of many science laboratories is often due to an excessive use of glass, rubber and similar materials. Modern engineering principles, materials and manufacturing methods have led to great improvements. The original research work carried out by the scientific staff of the Company has led to many important developments. In particular, the discovery of the Apiezon series of low-pressure oils and distillates has led to highly important advances in vacuum technique. Valves, X-ray tubes, etc., can now be taken to pieces for repair and adjustment and then re-assembled for use. They can also be made of materials like metal and porcelain and so have not the disadvantages of permanently sealed glass apparatus. The physics and engineering staff have done excellent pioneering work in many branches of research. Their vacuum furnaces, their arrangement of apparatus to apply testing pressures of a million volts continuously and their testing methods for impulse pressures as high as one and a half million volts are scientific triumphs. In developing apparatus for measuring noise they have broken new ground. The principle on which the apparatus works is that of aural comparison of the complex noise under observation with a pure reference tone of fixed frequency but adjustable amplitude. By listening simultaneously to the two sounds and adjusting the loudness of the reference tone until it sounds as loud as the noise under observation, the loudness of the complex noise can be expressed, by an experienced observer, in terms of that of the simple reference tone.

Railway Electrification Experience

COL. CORTEZ LEIGH, electrical engineer to the London, Midland and Scottish Railway Co., read a paper to the Institution of Electrical Engineers on April 6, which attracted a large audience. He described the experience gained by working the electrical railway between Manchester and Altrincham, a distance of about nine miles, since it was opened in May 1931. It appears that notwithstanding the competition of a recently inaugurated express bus service, the increase in the passenger traffic was 35 per cent. This is attributed to the greatly accelerated service made possible by electrification and to the increased comfort of travelling. Another reason is the great success of the 1,500-volt mercury arc rectifiers, the first used in Great Britain for railway work, for converting the alternating current supply into direct current for the railway motors. It looks as if these devices would come into general use, seeing that the 1,500 volt D.C. system was standardised by the Pringle Committee in 1927. This will make it easy to merge into a general scheme of main line electrification later. In the discussion, H. W. H. Richards, electrical engineer of the London and North Eastern Railway, compared the straight electric drive adopted on this line with the Diesel electric drive which has been much advocated lately. He calculated that the straight electric drive takes forty per cent less power. Prof. W. Cramp referred to the wear of the overhead conductors which are in contact with the pantograph collectors. It has been found that the wear of the conductors when the wires are oiled is about six times less than when there is no oil. Sir Josiah Stamp said that the results obtained on this line have more than fulfilled expectations.

The Palæontographical Society

THE eighty-sixth annual meeting of the Palæontographical Society was held in the rooms of the Geological Society, Burlington House, on Friday, April 28, Dr. F. L. Kitchin, vice-president, in the chair. The annual report recorded the publication of vol. 84 of the monographs, containing instalments of the Corallian Lamellibranchs, Gault Ammonites, and Cambrian Trilobites. It is anticipated that vols. 85 and 86 will be issued during the present year, thus bringing the publications more nearly up to date. Dr. F. A. Bather, Mr. Robert S. Herries, and Sir A. Smith Woodward, were re-elected president, treasurer, and secretary respectively; and Mr. F. H. Edmunds, Dr. W. D. Lang, Prof. S. H. Reynolds, and Prof. W. W. Watts were elected new members of council.

Science Forum

HOWEVER on financial grounds the apparently unending stream of new scientific organisations and publications may be deplored, one cannot honestly withhold sympathy when these are founded with the object of promoting international co-operation in the general advancement and practical development of science in all its phases. The first issue of the *Science Forum*, the quarterly journal of the International Faculty of Sciences, is therefore of interest as an indication of the manner in which it is proposed to achieve these objects. The articles include discussions on the relation of science and religion by Dr. Ernst Almquist, and on changes in moral ideas likely to result from the study of psychology in relation to ethics by Dr. R. Money-Kyrle. W. H. Wakinshaw's "Consufiatia" provides a useful elucidation (with an unconvincing solution) of the world's economic problems, and an interesting note on the gladiolus scab and its prevention comes from

R. H. Jeffers. The articles are written in a semi-popular strain with, however, a slight tendency to emphasise the sensational which should be firmly repressed if the publication is to carry weight among scientific workers or thinking laymen.

Auguste Rateau, 1863–1930

THE late Prof. Auguste Camille Edmond Rateau, whose death was recorded in NATURE of February 8, 1930, held a chair at the School of Mines at St. Étienne for about ten years. When, in 1897, he resigned this position, he was succeeded by M. Emile Jouquet, who in the *Annales des Mines* for September 1932 gives a full account of the researches and inventions of his distinguished predecessor. The son of an architect, Rateau at an early age gave signs of mathematical talent and when he completed his two years' study at the Ecole Polytechnique, he passed out at the head of his class. He was twenty-five years of age when in 1888 he was made a professor in the School at St. Étienne, where previously, as M. Jouquet says, Burdin was a professor and Fourneyron, "the Watt of the hydraulic turbine", was a student. Rateau's work was in direct line with theirs and from it came the Rateau mine ventilators, centrifugal pumps and steam turbines. The impulse steam turbine of Rateau was applied to a French torpedo boat in 1904 and Rateau turbines, as developed by the Ateliers et Chantiers de Bretagne, Nantes, have recently been fitted in the fastest flotilla leaders in the world. A prominent member of many societies, Rateau was elected a member of the Paris Academy of Sciences in 1919. A monument to him was unveiled on January 17, 1931, in the grounds of the works of the Société Rateau at La Courneuve (Seine).

Expedition to South-Eastern Honduras

THE Smithsonian Institution, Washington, D.C., announces the dispatch of an expedition of archæological exploration to the Chorotegan area of south-eastern Honduras. The members of the expedition are Messrs. Alan Paine, W. D. Strong and Norman Haskell. The Chorotegan area is one of the least known in the whole of America and no trustworthy maps of it exist. The object of the expedition is to locate and determine the character of ancient ruined-city sites, to collect specimens of bird and animal life, and to get into touch with the practically unknown Payas and Sumu Indians, whose language, thought to be linguistically on the border line between North and South America, may throw light on the language of the ancient Maya. The specific problem to be investigated is the possibility that the culture of this area may have been a southward extension of the Mayan 'New Empire' of Yucatan, three hundred miles to the north. From time to time, natives and chicle hunters have reported the existence of ancient ruined stone cities in this area, and it is believed that it was from here that the Maya obtained the precious metals and the turquoise, of which they made such extensive and elaborate use in their decorative art.

Air Survey Methods

THE increasing use of aerial photography for mapping makes the publication of a simple handbook on the subject very welcome. This has been written by Lieut. J. S. A. Salt under the title of "A Simple Method of Surveying from Air Photographs" and published as No. 8 of the Professional Papers of the Air Survey Committee (London: H.M. Stationery Office, 4*s*.). The book aims at explaining the methods required in the production of medium-scale maps based on a limited ground control and involving the use of comparatively simple apparatus. The demands made on pilot and navigator are explained and there is a full discussion of the relation between ground control and plotting and the problems of the cartographer in general. The work is clearly written and amply illustrated with diagrams and plates. It should prove a useful guide and textbook.

Announcements

DR. C. TATE REGAN, director of the British Museum (Natural History), has been elected a foreign member of the Royal Danish Academy.

MR. CHARLES AUGUSTUS CARLOW was elected president of the Mining Institute of Scotland at the annual general meeting held on April 26.

THE Rubber Industry Bill was introduced in the House of Lords by Lord Irwin, president of the Board of Education, on May 2, and read a first time. The Bill provides for contributions by the rubber manufacturers in the United Kingdom to the Research Association of British Rubber Manufacturers, and for the collection and application of such contributions.

THE Challenger Society for the Promotion of the Study of Oceanography is offering a sum of money, not exceeding £25, for the assistance of a suitable student (or students) carrying out research at any of the marine laboratories. Application should be made to the Hon. Secretary, Mr. J. R. Norman, British Museum (Natural History), South Kensington, S.W.7.

FROM the interest of the Sir George Beilby Memorial Fund, awards are made to British investigators in science to mark appreciation of records of distinguished original work, preference being given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering and metallurgy. Two awards of £250 each were made in 1930, and two awards of £105 each in 1932. The administrators will meet in June, and will be glad to have their attention directed to outstanding work of the nature indicated. Correspondence should be addressed to the Convener, Sir George Beilby Memorial Fund, The Institute of Chemistry, 30, Russell Square, London, W.C.1, not later than June 1.

THE Rockefeller Medical Fellowships for the academic year 1933–34 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than

June 1. These fellowships are awarded to graduates who have had some training in research work in the primary sciences of medicine, or in clinical medicine or surgery, and are likely to profit by a period of work at a university or other chosen centre in the United States before taking up positions for higher teaching or research in the British Isles. In special circumstances, the fellowships may be tenable at centres of research not in the United States. A fellowship held in the United States will have the value of not less than £350 a year for a single fellow, with extra allowance for a married fellow. Full particulars are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

Additional lists of articles chargeable with duty under Part I of the Safeguarding of Industries Act, 1921, have been issued by the Board of Trade, and will take effect as from May 12. These lists refer to articles under the following headings:—Optical Instruments; Scientific Glassware; Scientific Instruments; Synthetic Organic and other Fine Chemicals. Copies of the lists may be obtained from His Majesty's Stationery Office, price 2*d*. net.

National Baby Week in Great Britain will be held on July 1–7, and among the topics for special consideration this year is preparation for parenthood. A conference on maternity and child welfare, organised by the National Association for the Prevention of Infant Mortality, will take place on July 5–7, at the Friends' House, Euston Road, London, N.W.1. Free displays of propaganda films in London are also being arranged. Further information can be obtained from the Secretary, National Baby Week Council, 117, Piccadilly, London, W.1.

As from July next, *Science Progress*, the well-known quarterly review of scientific thought, work and affairs, will be published by Messrs. Edward Arnold and Co., London (7*s*. 6*d*. net per copy). The principal features of the review are being retained by the new publishers, though typographical improvements are being made. Each issue will contain at least one article by a leading man of science describing work with which he has been identified; in the July number this feature will be contributed by the Astronomer Royal, Dr. H. Spencer Jones.

John Evelyn's "Fumifugium or the Inconvenience of the Aer and Smoake of London Dissipated", dedicated to Charles II and published in 1661, has been reprinted by the National Smoke Abatement Society, with an introduction by Rose Macaulay (National Smoke Abatement Society, 23, King Street, Manchester; 1933. Paper, 6*d*. net; cloth, 1*s*. 6*d*. net). Modern work on atmospheric pollution shows that conditions in London have changed, and that it is the domestic fire rather than the factory which is now fouling the air. Nevertheless, Evelyn's pungent invective and constructive proposals make interesting and entertaining reading. It will be recalled that the pamphlet was also reissued as an Old Ashmolean Reprint three years ago (Oxford: Dr. R. T. Gunther, Folly Bridge, 1930. 2*s*. 6*d*.) and was reviewed at length in Nature of March 8, 1930, p. 368.

In a notice of the second edition of Pohl's "Einführung in die Mechanik und Akustik" in Nature of April 22, p. 568, the hope was expressed that an English translation would be made available. Messrs. Blackie and Son, Ltd., have reminded us that they have already published an English translation of this edition of Pohl's book. It was reviewed in Nature of March 4, p. 320.

A biography entitled "Charles Parsons—His Life and Work" by Rollo Appleyard, will be published on May 11 by Messrs. Constable and Co., Ltd. The book contains the life-story of the Hon. Sir Charles Parsons, whose achievement in developing the modern turbine and dynamo, and in applying them to the propulsion of ships and for power stations, marks him as one of the leading engineers of his time.

Prof. Julian S. Huxley has accepted the invitation of Messrs. Thornton Butterworth Ltd. to become science editor of the "Home University Library", in succession to the late Sir J. Arthur Thomson. The "Library", founded in 1911, and added to each year, now consists of more than 160 volumes covering the chief subjects in history and geography, literature and art, science and social science, philosophy and religion. Prof. Huxley joins the Right Hon. H. A. L. Fisher and Prof. Gilbert Murray on the editorial side.

Applications are invited for the following appointments, on or before the dates mentioned:—A technical assistant to the Secretary of the Institution of Structural Engineers—The Secretary, 10, Upper Belgrave Street, S.W.1 (May 10). A head of the School of Architecture and Building in the Technical College and Central School of Arts and Crafts, Plymouth—The Secretary for Education (May 12). A student assistant in agricultural economics in the Department of Agriculture and Horticulture at the University of Bristol—The Agricultural Officer, 22, Berkeley Square, Bristol, 8 (May 12). A principal of the Kenton Lodge Training College for Women, Newcastle-upon-Tyne—The Director of Education, Education Office, Northumberland Road, Newcastle-upon-Tyne (May 15). An assistant pathologist to the Infirmary and demonstrator of pathology in the University of Sheffield—The Registrar (May 17). A full-time engineering workshop instructor in the Municipal Technical School, The Gamble Institute, St. Helens—The Secretary for Education, Education Office, St. Helens (May 22). An assistant engineer to the Great Yarmouth Water Works Co.—The Secretary, 84, York Road, Great Yarmouth (May 22). Five district veterinary officers in the Public Health Department of the Cheshire County Council—The Clerk to the County Council, County Offices, Chester (May 27). Robert Blair fellows in applied science and technology, tenable overseas—The Education Officer (T.3), County Hall, London, S.E.1 (June 1).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Egyptian Neolithic Barley

WHEN, where and with what species man first began the cultivation of grain are questions intimately bound up with the development of our civilisation. Fresh light has been thrown on these questions by specimens of grain which were found a few years ago in the course of explorations carried out in Egypt by Miss G. Caton-Thompson and Miss E. W. Gardner, who have given preliminary accounts of their work in two papers[1]. The archæological and geological evidence given in these papers shows that this grain was grown between 5,000 and 6,000 B.C. by a people in a Neolithic state of culture, living on the shores of a lake, which still exists, though now much smaller than in Neolithic times.

In the course of the work, more than a hundred small straw-lined pits were found which had served as granaries. Most were empty but several contained agricultural implements, and eight, varying quantities of grain, which, in five cases, was entirely or mainly wheat, but, in three, to a large extent barley.

The number of varieties of barley in cultivation is very great, amounting to several hundreds; these varieties or, at any rate, groups of them, are fairly well confined to different parts of the world. As my work during a good many years past has made me familiar with many of them, I thought it would be interesting to see how these ancient specimens compared with modern barleys; by the kindness of Miss Caton-Thompson, I have been able to do so.

Of the three specimens containing barley, one was found to be in a practically perfect state of preservation; some 800 corns were examined, with the following results:—

Wheat	20 per cent
Barley (6-rowed) ..	57 ,,
,, (2-rowed) ..	23 ,,

As I have no special knowledge of the varieties of wheat, I did not examine this further but confined my attention to the barley, the characters of which were compared with those of modern barleys grown not only in Egypt but also in other Eastern countries, namely, Tunis, Syria, Danubian countries, Persia and India. The result of this comparison was to show that this prehistoric barley was to all intents and purposes identical with that in cultivation in Egypt at the present time and clearly distinguishable from the barleys now grown in the other countries mentioned.

These facts give rise naturally to the thought that, since no appreciable improvement can be seen to have taken place in it during the last seven thousand years, a very long time must have been needed for this barley to have developed from the wild state to the degree of perfection which this specimen shows; in other words, the origin of agriculture must have been long before 5,000 B.C.

The other evidence collected by Miss Caton-Thompson and Miss Gardner permits of a few more conclusions being drawn as to the part which cereals and their cultivation played in the lives of these people.

From the size of the pits and on the assumption that the contents of each pit were the produce of one area and the property of one family of, say, 5–10 persons, it is evident that these people were not essentially an agricultural folk, for the proportion of grain in their food supply was less than in modern England, whereas in truly agricultural populations like those of India or China, it is very much higher. Its cultivation must have made small demands upon their time, which must have been spent mainly in fowling and fishing. They were, therefore, a people in the interesting intermediate stage between hunting and agriculture, and it is significant that we find them on the borders of a lake, for the presence of water must have been a most important, if not the most important, factor in bringing about the difficult transition between hunting and agriculture. A hunter is essentially a wanderer; an agriculturist essentially a settler. Even if the brilliant idea of growing wild grass instead of merely gathering it did occur to a hunter, there would be little inducement for him to do so, for the game might move away at any time and he could never be sure that he would be able to return at the right time to reap it nor could he give it any attention while growing. But if, as in this case, he were already more or less anchored to a spot where it was easy for him to obtain his food supply by the methods of hunting and fishing, with which he was already familiar, he would be very favourably placed for supplementing it by practising the newer method of tilling the ground.

A. JACKSON.

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Feb. 23.

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[1] "The Recent Geology and Neolithic Industry of the Northern Fayum Desert" (*Journal of the Royal Anthropological Institute*, vol. 56, 1926) and "Recent Work on the Problem of Lake Moeris" (*Geographical Journal*, vol. 73, 1929).

Chemical Detection of Artificial Transmutation of Elements

IF detection of elements originating from artificial transmutation can be attained by chemical methods, not only will this mean a desirable checking of physical observations, but also new results may thereby be obtained. For physical means of discerning the transmutation of elements—whether by observing scintillations or by electrical methods—presuppose that the atoms which originate are expelled with a certain minimum energy; processes which take place with lesser energy remain at present unknown to us, even although they are perhaps quantitatively more important than the already ascertained cases of artificial disintegration of atoms.

First may be discussed the question whether the hitherto known modes of artificial disintegration of atoms offer any prospect of giving sufficiently large amounts of matter for a chemical test of the new products. Here we will confine ourselves to hydrogen, helium and neon, as so far we have worked only on these elements, and because the methods of their analysis are amongst the most sensitive of all. Several years ago we ascertained[1] that under the most favourable conditions the practical detection-limit for helium is within the order of magnitude of 10^{-10} c.c. (that is, about 10^{10} atoms), and that one can recognise with certainty 10^{-9} c.c. helium (about 10^{11} atoms). As hydrogen and neon possess lower excitation potentials than helium, the presence of these two gases as small admixtures can be spectroscopically observed; according to an early statement of Collie and Ramsay[2], 10^{-3} per cent of hydrogen in helium can still be recognised. Since by our method the slight amount of helium, which forms from the α-rays used for the artificial disintegration of atoms, can be isolated and spectroscopically examined[3], there would therefore be a possibility of finding in this the content of hydrogen originating from atomic disintegration, if its quantity stood in no more unfavourable ratio than that of 1 : 100,000 to the helium. Now, in many cases of artificial atomic disintegration, the yield of hydrogen is at least of this order; and it seemed therefore not altogether unpromising to attempt spectroscopically to detect hydrogen originating in the disintegration of atoms by α-rays.

Our numerous experiments in this direction have been unsuccessful, for the reason that it was not possible for us with small amounts of helium to verify Collie and Ramsay's statement. We have not succeeded in preparing in glass vessels helium which was with certainty free of hydrogen; as Collie and Ramsay say nothing about hindering hydrogen liberation from the glass, it seems to us that the hydrogen lines observed by them may have been due to some contamination rather than that they should be attributed to the intentionally added amount.

Much more favourable are the circumstances for testing neon in helium. Here the influence of glass walls, and the danger of deception through the leakage of neon from the atmosphere, can be precluded. We have found that down to 2×10^{-5} per cent neon in helium can certainly be detected, and probably even less. This gave a possibility of proving whether, by bombarding a substance with α-rays, neon originates in larger amounts than 1 atom to 100,000 α-particles. Hitherto we have had only negative results (the limits of which are nevertheless so low that they are not uninteresting); we were able to ascertain that by bombarding oxygen with α-rays, such neon as may be formed falls short of that proportion; herein, as pointed out above, is included any rayless production of neon. Other experiments in bombarding the fluorides of potassium and sodium with α-rays also gave no definite positive effects.

At present the best prospects for spectroscopic identification are given by helium originating in consequence of a bombardment of lithium, boron, etc., with protons, according to Cockcroft and Walton's process[4]. The number of from 10^{10} to 10^{11} helium atoms, which is necessary for the application of our method, must form themselves in reasonable time if a somewhat stronger stream of protons is applied and the main amount of helium developed is intercepted; if we can assume that helium rays of even shorter range than those already known are present, then the prospects of results are still more favourable. We are now occupied, in conjunction with physical laboratories, in chemically isolating, and spectroscopically testing, the helium originating after bombardment with protons; also the effect of electrons of high speed on the formation of helium is being investigated.

We have also made experiments to find out whether helium appears after bombardment with β-rays or neutrons. In the case of both these rays, the abovementioned extremely small amounts of helium would be detectable, but as yet the use of moderately strong radio-active preparations (about 50 mgm. of radium) has given no suggestion of the formation of helium[5]. The proof of helium originating under α-bombardment is naturally less sensitive by many orders of magnitude; the quantity of newly produced helium would need to amount to several per cent of that originating from the α-rays, and such a yield of an artificial transmutation would surpass all that has hitherto been observed in this sphere. Nevertheless it seemed to us worth while using our micro-method of quantitative helium measurement[6] to ascertain the amount of helium which developed from various substances after bombardment with the unfiltered rays of thorium-B and thorium-C, namely, with a mixture of α-, β-, and γ-rays and recoil atoms.

While with water, carbon, potassium, tin and mercury the amount of helium found corresponded, within a ten per cent limit of error, to the number of α-particles which had been shot into the substance, in the case of carbon-hydrogen compounds, such as paraffin, palmitic acid and diphenyl, we have found surpluses up to a hundred per cent. We hope to interpret this surprising phenomenon after further experiments; but as the completion of our work may be hindered, we therefore make this preliminary statement.

F. A. PANETH.
P. L. GÜNTHER.

Chemical Institute,
University of Königsberg i. Pr.
April 7.

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[1] F. Paneth and K. Peters, *Z. phys. Chem.*, **134**, 353; 1928. See also NATURE, **123**, 879, June 8, 1929; **125**, 490, March 29, 1930.

[2] J. N. Collie and W. Ramsay, *Proc. Roy. Soc.*, **59**, 257; 1896.

[3] Cf. *Z. phys. Chem.* (B.), **1**, 170, 185; 1928.

[4] J. D. Cockcroft and E. T. S. Walton, *Proc. Roy. Soc.*, **137**, 229; 1932. NATURE, **131**, 23, Jan. 7, 1933. See also H. Rausch v. Traubenberg A. Eckardt and R. Gebauer, *Naturwissenschaften*, **21**, 26; 1933.

[5] Cf. the earlier, also negative, results, *Z. phys. Chem.* (B), **1**, 180, 182; 1928.

[6] F. Paneth and Wm. D. Urry, *Z. phys. Chem.* (A), **152**, 110; 1931.

Orientations of Molecules in the *p*-Benzoquinone Crystal

THE crystal structure of *p*-benzoquin recently been studied by W. A. Caspari[1] methods. The crystal belongs to the system and is assigned by Caspari to t group C^5_{2h}; there are two molecules in t ntra of cell, the molecules possessing a centre of sym an s His X-ray measurements are not sufficient to de der mine uniquely the orientations of the molecules the unit cell. However, by combining his X-ray data with certain considerations concerning the crystal habit and the dimensions of the molecules, he concludes that the molecular planes are parallel to (201) and that the lines joining the two oxygen atoms of the molecule lie in the (010) plane. This orientation of the molecules secures a large concentration of the oxygen atoms in the $(20\bar{1})$ plane, which concentration, according to Caspari, will account for the exceptional development in the crystal of so peculiar a face as $(20\bar{1})$.

It seems to us that the molecular planes in the crystal are orientated differently. A study of its magne-crystallic properties shows that the $(20\bar{1})$ plane is indeed the mean plane of the molecules. Denoting by χ_1 and χ_2 the principal gram molecular susceptibilities of the crystal in the (010) plane, and by χ_3 the susceptibility along the *b* axis, we find that

$$\left.\begin{array}{l}\chi_1 = -27\cdot 1\\ \chi_2 = -64\cdot 5\\ \chi_3 = -25\cdot 4\end{array}\right\} \times 10^{-6} \text{ c.g.s. e.m.u.}$$

The χ_2 axis, which is plainly an axis of approximate magnetic symmetry, is inclined at 20·2° to (001) and at 87·0° to ($20\bar{1}$).

We may compare the above principal susceptibilities of the benzoquinone *crystal* with those for the *molecule* of the substance—deduced from the known constants for the benzene molecule. We then find that χ_1 and χ_3 are about the same as the susceptibility of the molecule for directions in its plane, while χ_2 is nearly equal to the susceptibility of the molecule along the normal to its plane. We may therefore conclude that the molecular planes in the crystal are perpendicular to the χ_2 axis, and are thus almost coincident with the ($20\bar{1}$) plane.

The orientation proposed by us is also supported by the optical properties of the crystal. Since the optical polarisability of the benzene ring for vibrations perpendicular to its plane is known to be considerably smaller than for vibrations in the plane, the refractive index of the crystal for vibrations perpendicular to ($20\bar{1}$) should be a minimum and be much less than the other two principal refractive indices. This is indeed so, since the crystal exhibits a strong negative birefringence, and the acute bisectrix is almost perpendicular to ($20\bar{1}$).[2]

K. S. KRISHNAN.
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March 5.

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[1] *Proc. Roy. Soc.*, A, 136, 82; 1932.

[2] See P. Groth, "Chemische Kristallographie", vol. 4, p. 140.

Detection of Traces of Carbon Monoxide in Air

A PARAGRAPH among the "Research Items" in ATURE of March 25, page 441, states that Dr. kermann has made comparative tests of two s of estimating carbon monoxide gas in air: dous chloride method and the hæmoglobin The latter method consisted in exposing globin to the gas to be examined; then a reducing agent (ammonium sulphide) to moglobin and examining it with an ordinary roscope for the presence of the two absorption nds of carbon monoxide hæmoglobin.

With palladous chloride it was possible to detect 0·015 per cent of carbon monoxide as against 0·13 per cent with the hæmoglobin method.

I should like to point out that there is a better hæmoglobin method than that used by Dr. Ackermann, which depends on the wave-lengths of the bands of oxyhæmoglobin being different from those of carbon monoxide hæmoglobin. Thus the α band has a difference of wave-length of about 60 angstrom units for ox, sheep or human blood. This change in wave-length can under suitable conditions be estimated with an accuracy of 1 angstrom unit by means of the reversion spectroscope.

Dudley, Edmed and Frederick have recently used this instrument[1] for investigating the production of carbon monoxide gas by various paints. Some of the air analyses showed values as low as 0·004 per cent carbon monoxide. Substituting this value for that obtained by the hæmoglobin method by Dr. Ackermann, the comparison with the palladous chloride method would now be:

Hæmoglobin method (with reversion spectroscope) ..	0·004
Palladous chloride method (Dr. Ackermann)	0·015

This reverses the conclusion reached by Dr. Ackermann, for the hæmoglobin method appears to be the more delicate.

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March 31.

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[1] *J. Indust. Hygiene*, 15, p. 1, Jan. 1933.

Radioactivity of Samarium and the Formation of Hibernium Halos

IN their interesting communication to NATURE for March 25, p. 434, G. Hevesy and M. Pahl have referred to Joly's work on the so-called hibernium halos. The agreement between their determination of the range of the α-ray radiation of samarium and Joly's[1] value is very striking. He found that the air equivalent of the radius of a hibernium halo was 1·15 cm., which may be compared with their figure for the range of the samarium α-ray of 1·1 cm. In his final estimate of the range of the hibernium α-ray Joly gave 1·5 cm. This figure was arrived at from the fact that in a normal positive uranium halo the boundary of the halo does not coincide exactly with the full range of the α-ray, due to the decreasing ionising power of the ray very near the end of its path. It must be remembered, however, that all the hibernium halos observed were reversed halos, and, as is shown later, it is probable that some non-radioactive reversal and intensification effect is necessary to render them visible, if they are samarium halos. Under these conditions it is possible that the radius of the halo would give practically the full range, which would thus agree nearly exactly with the samarium α-ray range.

When we consider whether a samarium nucleus of the size observed in the hibernium halo would furnish sufficient α-ray radiation to produce a halo since Archæan times, we encounter certain discrepancies. The radius of a hibernium halo is 5×10^{-4} cm., with a central nucleus of about 3×10^{-5} cm. radius. If this nucleus were a pure samarium sphere, its mass would be $8\cdot 7 \times 10^{-13}$ gm. Using Hevesy and Pahl's value for the number of α-rays per gram of samarium, that is, 75 α-rays per gram per second, this sphere would emit $2\cdot 0 \times 10^{-3}$ α-rays per year. Taking a rough figure for the age of the Archæan of 10^9 years, and allowing for the total volume of the complete halo sphere, we arrive at a total number of α-particles per cubic centimetre of halo sphere of $4\cdot 0 \times 10^{15}$.

Unfortunately, no quantitative measurements on the effect of α-rays on the very opaque Ytterby mica are available. Joly and Rutherford's[2] experiments on Ballyellen mica show that it requires about 2×10^{14} α-particles per cubic centimetre to produce an amount of staining corresponding to a weak positive halo in this material. The amount of α-ray radiation required to produce a reversed halo must be very much greater than this, as is shown by Jedrzejowski's[2] work on the production of reversal by α-ray radiation of a Siberian mica. Thus if we are to assume that hibernium halos are due to samarium, we must either conclude that Ytterby mica is specially sensitive to α-ray radiation, or that some reversal and intensification of the halos has been produced by either thermal or chemical effects in the course of their long history. I am inclined to favour the latter alternative, since I have observed a similar intensification of positive halos when heated to a temperature not sufficient to obliterate the halo by the blackening of the surrounding mica[4]. Joly, also, has observed the reversal of immature uranium halos in Ytterby mica. The fact that hibernium halos are so rare, even in Ytterby mica, is perhaps explicable on the view that the conditions for the reversal and intensification of the halos are only very occasionally satisfied.

J. H. J. POOLE.

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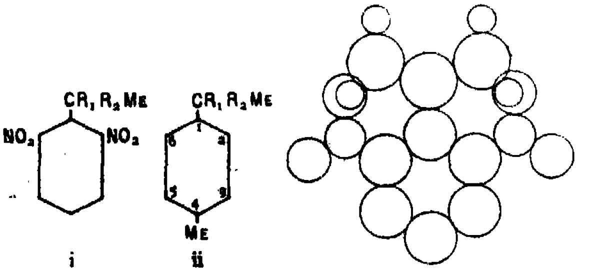
March 29.

[1] *Proc. Roy. Soc.*, A, **102**, 682; 1923.
[2] *Phil. Mag.*, p. 644, April 1913.
[3] *C.R.*, **186**, 135; 1928.
[4] *Phil. Mag.*, p. 132, Jan. 1928.

Volumes of Alkyl Groups and their Orienting Powers

IN some of their applications, the current generalised theories of benzene substitution discard steric factors too lightly. For the purpose of *a priori* consideration, it can be assumed that the effective reagent in a substitution does not occupy a *smaller* volume than the group which is eventually installed in place of hydrogen.

A drawing to scale[1] is reproduced (Fig. 1) of the compound (i): the groups R_1 and R_2 are omitted and the two positions which could be taken by the methyl group in the plane of the benzene ring are indicated.



Scale drawing of (i)

FIG. 1.

It is seen that some degree of interlocking of groups occurs. Various applications of this are at present under investigation; for example, that during nitration of (ii), attack by HNO_3 molecules at the 2- and 6- positions might be impeded by a real screening effect from the $-CR_1R_2Alk$ radical. To a less extent the same might apply to halogenation. Thus the absolute number of reagent molecules colliding with these positions may be less than those colliding at 3- and 5-, and/or some of the reagent molecules may succeed in penetrating to the 2:6-carbon atoms only after preliminary collision. In the last case, their kinetic energies being reduced, the threshold energy of activation necessary for substitution is likely to be attained less frequently than among the more direct collisions occurring at positions 3- and 5.

Expressed differently: if velocities of substitution can be represented by $k = \alpha\, e^{-E/RT}$, then in compounds of the type now under discussion the two pairs of vicinal positions available for substitution will be abnormal in not having identical α terms (contrast Bradfield and Jones's results[2]). Such abnormality must be expected with all alkyl substituents larger than methyl.

The net consequence will be a depression of substitution ortho to the radical, $-CR_1R_2Alk$ in favour of other positions where substitution will be able to occur by default. Thus orientation in discord with electronic theories (requiring substitution more at positions of greater electron availability) should be expected from *a priori* reasoning alone.

Experiments on the nitration and halogenation of *p*-cymene and some of its derivatives have justified this conclusion. The results with the hydrocarbon itself are tabulated:

2-Substitution in 1-methyl-4-isopropylbenzene.

268 G *p*-cymene subjected to:—	Total wt. of crude material isolated	Unchanged *p*-cymene recovered	Theoret. yield for mono substn.	Pure 2 substd. cymene obtd.	Per cent in crude product.	Per cent yield on cymene taken
Nitration .	290	—	358	252	87	70
Chlorination .	318	1	338	200	63	59
Bromination .	376	19	396	214	57	54

The numbers in the last column give minimum estimates of the yields of 2-derivatives obtained in these experiments. The amount of actual 2-substitution of *p*-cymene in each case is certainly greater than is indicated by these results. Thus methyl appears to possess a greater ortho directive influence than isopropyl. On pure electronic theories the reverse should be the case.

R. J. W. LE FÈVRE.

University College,
University of London.
April 11.

[1] "Atomic Radii", *An. Rep. Chem. Soc.*, p. 402; 1931.
[2] Bradfield and Jones, *J. Chem. Soc.*, 1009; 1928.

Nuclear Moment of Arsenic

THE hyperfine structure of two-electron spectra of heavy elements with configurations involving an *s* and one other type electron have been under investigation for some time in this laboratory. The As IV spectrum, classified by K. R. Rao[1], is of this type, and is particularly suited for the detection of hyperfine structure and the determination of the moment of the nucleus. About a year ago, the As IV lines λ3216, 3190, 3109 ($4s5s\,{}^3S_1 - 4s5p\,{}^3P^\circ_{012}$), excited by a condensed electrodeless discharge, were examined with a multiple prism spectrograph and found to have comparatively large hyperfine structures. The patterns, although not completely resolved, showed that the *I* value of arsenic was small and probably equal to 1½. The recent acquisition by this Department of an excellent 21 ft. concave grating, ruled by Prof. Gale of Chicago, has made possible the completion of this investigation. The results definitely show that the nuclear moment of arsenic is 1½ × $h/2\pi$.

The line λ3216 ($^3S_1 - {}^3P^\circ_0$) is well resolved in the fifth order, and shows three components decreasing in intensity from the red to the violet and separated by the intervals 0·907 and 0·544 cm.$^{-1}$. Since the $^3P^\circ_0$ term is not split by the nuclear interaction, the triple line-structure corresponds directly to the hyperfine structure of the $^3S_1$ term. This triplet structure shows that $I \geqslant 1$, and the interval ratio definitely fixes I as $1\frac{1}{2}$. Theoretically, the interval ratio for a term with $J = 1$ is $(I + 1)/I$. The observed ratio, obtained by averaging twenty measurements from two plates, is $0{\cdot}907/0{\cdot}544 = 1{\cdot}67$. It is evident that the only value of I that satisfies this ratio is $1\frac{1}{2}$. The intensities are consistent with this value of I and they, with the intervals, show that the hyperfine levels of $^3S_1$ are normal.

The lines λ3190 ($^3S_1 - {}^3P^\circ_1$) and λ3109 ($^3S_1 - {}^3P^\circ_2$), although not completely resolved in the fifth order, both show four distinct components. These structures were interpreted by Fisher and Goudsmit's method for incompletely resolved patterns[2]. In both cases the positions and the intensities[3] of the fine structure components were consistent with the predictions based on the known separations of the $^3S_1$ term, obtained from λ3216, and on the deduced value $1\frac{1}{2}$ for I, which was used to determine the interval ratios of the $^3P^\circ_1$ and $^3P^\circ_2$ terms.

The interval factor of $^3S_1$ is $A(^3S_1) = 0{\cdot}363$ cm.$^{-1}$. The interval factors of the other two terms are $A\,(^3P^\circ_1) = 0{\cdot}18$ cm.$^{-1}$, and $A\,(^3P^\circ_2) = 0{\cdot}15$ cm.$^{-1}$. The last two were determined by the graphical method and are not so accurate as the first. The approximate equality of $A\,(^3P^\circ_1)$ and $A\,(^3P^\circ_2)$ shows that the coupling in the $4s5p$ configuration approximates to the (LS) type[4]. This is consistent with the multiplet separations of the $4s5p\ {}^{3,1}P$ terms: although the interval ratio 3·2/1 for the $^3P^\circ_{012}$ separations[1] differs appreciably from the ratio 2/1, the g-factors calculated by Houston's method[5] depart only slightly from those for (LS) coupling.

The nuclear moment deduced from the hyperfine structures of these As IV lines is in agreement with the value deduced by Tolansky[6] from the hyperfine structure of As II. His publication appeared during the course of this investigation.

The $4s5p$ configuration of As IV and the $4p5s$ configuration of As II illustrate nicely the influence of binding on coupling. The coupling energy between the s and p electrons is expected to be about the same for both configurations. The (ls) interaction of the p electron in the $4p5s$ configuration is expected to be from two to three times that of the p electron in the $4s5p$ configuration. This follows from an application of the Landé doublet formula when the screening effect of the two $4s$ electrons[7] and the variation in n^* are taken into consideration. Due to this increase in the (ls) interaction relative to the interaction energy between the two electrons, the coupling in the $4p5s$ configuration should depart more from (LS) type than the coupling in the $4s5p$ configuration. This is consistent with observation: the coupling in $4s5p$, as pointed out, approaches (LS) type, whereas the coupling in $4p5s$ differs considerably from (LS) and tends toward (jj), as shown by the application of Houston's theory[5] to the multiplet separations and of Goudsmit's theory[4] to the hyperfine separations of As II.

In this research, hyperfine structure was also observed in several unclassified spark lines. These structures are being investigated.

The authors wish to thank Prof. E. F. Burton, director of the Laboratory, who co-operated and made possible the completion of the investigation by procuring the new grating.

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March 10.

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[1] K. R. Rao, *Proc. Roy. Soc.*, A, **134**, 604; 1931.

[2] R. A. Fisher and S. Goudsmit, *Phys. Rev.*, **37**, 1057; 1931.

[3] E. L. Hill, *Proc. Nat. Acad. Sci.*, **16**, 68; 1930.

[4] S. Goudsmit, *Phys. Rev.*, **37**, 663; 1931.

[5] W. V. Houston, *Phys. Rev.*, **33**, 297; 1929.

[6] S. Tolansky, *Proc. Roy. Soc.*, A, **137**, 541; 1932. NATURE, **129**, 652; 1932.

[7] R. A. Sawyer and C. J. Humphreys, *Phys. Rev.*, **32**, 583; 1928.

Photochemical Reaction of Hydrogen and Chlorine

PROF. BAKER and I have talked over the matter dealt with in his letter to NATURE published in the issue of January 7, p. 27, namely, the influence of traces of water vapour on the above reaction. We agree that no further discussion of the point at issue would be useful unless combined with a simultaneous first-hand and detailed examination of the experimental method used. This is impossible, as the apparatus in question has been dismantled. We therefore, for the time being at all events, hold to our respective and divergent views on the subject.

About three years ago Dr. J. B. Bateman, working in this Laboratory with dispersed monochromatic light, obtained results which indicated that the quantum efficiency for this reaction fell off in the ultra-violet, and became practically zero somewhere below 3000 A. Recent experiments carried out by Mr. H. C. Craggs under rather different conditions have shown that the results were due to the presence of a plate of glass, instead of quartz, at the exit side of the thermopile mounting in which the telescope slit of the monochromator is incorporated. This in turn was due to an unfortunate misunderstanding for which we can take no responsibility. In view of the extraordinary nature of the original conclusion, Dr. Bateman's work was not published in full, pending further confirmation. The results have, however, been quoted on two occasions—at a Faraday Society discussion in April 1931 and in a contribution to a Chemical Society discussion held in December 1931. On that account I think that a formal withdrawal is necessary.

A. J. ALLMAND.

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March 31.

Sacred Sandstone of the Mayas

ALL archæologists are familiar with the work done on the remarkable Maya ruins at Chichen Itzá, in Yucatan, by Mr. Earl Morris and his associates, on behalf of the Carnegie Institution of Washington (see NATURE, 128, 692, Oct. 24, 1931). In the course of uncovering the large building now known as the Temple of the Warriors, Mr. Morris found an older temple underneath it, which he was able to explore by means of suitable tunnels. It was in the basement of this older building that he found the beautiful turquoise plaque, now carefully restored so far as the materials permitted, and deposited in the National Museum of Mexico. The centre of this plaque consists of a circular area which was filled with pieces of polished hæmatite, and beneath this, as Mr. Morris has fully explained in his recent book, is a disc of sandstone, of very ordinary quality, but not obtainable near Chichen Itzà.

The exact meaning of all this has remained uncertain. Mr. Morris found other discs of sandstone in the foundations of the later temple, and had inferred that they must have been held sacred, without suggesting any reason beyond their position and the fact that they were carefully protected from injury. While hearing Mr. Morris lecture on this subject, it occurred to me that in all probability the discs were connected with human sacrifices. The porous stone would become largely saturated with blood, and would thus afford a means of preserving the actual blood of the sacrificial victim in the foundations of the temple. The symbolism of the covering hæmatite would then be evident; it would present the appearance, when polished, of a pool of blood. Further confirmation appears to be afforded by the discovery, in an adjacent building, of another plaque and with it, covered with turquoise, a large knife or blade. This might have been the sacred instrument used in killing the victim. It is a question whether careful analysis would reveal any traces of blood now remaining in the sandstone discs, but it seems not impossible that this might be the case.

After consulting with Mr. Morris, I offer this note to direct attention to the matter, hoping that someone may be able to supply decisive evidence.

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March 6.

Recording Wireless Echoes at the Transmitting Station

RECORDS of wireless echoes by the group-retardation method of Breit and Tuve[1] show that the intensities and number of echoes diminish as the receiver is brought near the transmitter. The minimum distance from the transmitter at which we could detect echoes was 400 metres[2]. The nearest distance at which interference phenomena between direct and sky waves have ever been noticed seems to be 180 yards[3]. The difficulty experienced in recording echoes at short distances from the transmitter is commonly supposed to be due to the enormous strength of the direct ground signal as compared with the strength of the echoes. This is undoubtedly one reason; but there is another reason to which proper attention has not been paid by investigators in this field.

FIG. 1.

In the group-retardation method, the transmitting aerial is energised for very short periods, for example, 1/5000 sec., at brief intervals of say 1/200 sec. The wave packet sent out during the active period of the aerial returns to the earth, during its quiescent period. During this latter interval, the transmitting aerial acts like a receiving aerial and collects energy from the reflected wave from over a comparatively large area surrounding it. The receiver with its small aerial, when brought within the 'collecting area' of the more efficient transmitting aerial, naturally fails to gather sufficient energy from the reflected wave and is unable to record the echoes.

It occurred to us that the difficulty mentioned above could be obviated if the transmitting aerial itself were utilised as a receiving aerial during its quiescent period when it absorbed energy from the reflected wave. Acting on this idea, the input coil of the receiver was coupled to the tuning inductance of the aerial, when echoes were recorded without much difficulty. A photograph of the echoes thus obtained is reproduced in Fig. 1. This, we believe, is the first record of echoes returned at absolutely normal incidence from the ionised layer. The direct signal of course comes out very strongly, but it can be kept down by suitable design of the receiver, such as by using an automatic volume control.

A great advantage of using the same aerial for transmitting as well as for receiving is that it dispenses with the necessity of erecting two stations, one transmitting and another receiving at two different localities, and employing two observers. A single observer is able to control and attend to both the transmitting and the receiving sides.

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University College of Science,
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Calcutta, March 25.

[1] Breit and Tuve, *Phys. Rev.*, **27**, 554; 1926.
[2] Mitra and Rakshit, *Phil. Mag.*, **15**, 20; 1933.
[3] Appleton and Naismith, *Proc. Roy. Soc.*, A, **137**, 36; 1932.

WE were much interested in a valuable paper by Mitra and Rakshit on "The Upper Ionized Atmosphere in Bengal"[1]. Their extension, to sub-tropical regions, of soundings of the ionosphere is very important. We are not concerned here to point out the bearing of the magneto-ionic theory on the results obtained by these authors, but the reading of the paper leads us to record one point arising from our experience of such work.

The receivers customarily used in pulse-reception at this Station are of the frequency-conversion type, with a band-width of 10 kc./sec., and with a diode as second detector. The ground distance between sender and receiver is only 120 metres, and the receiver was designed with such time-constants that the heavy overloading produced by the ground-pulse did not appear to lengthen the duration of the corresponding output-pulse as seen on the cathode ray oscillograph. This arrangement gives very satisfactory echo-patterns, and meets all our immediate requirements.

We were recently disconcerted to find, however, that the receiver as a whole was rendered relatively insensitive, for periods of many milliseconds, by the incidence of the strong ground-pulse, so that the electric forces, particularly in the earlier members of the echo pattern, were in fact higher than would have been inferred from the screen amplitudes and the steady state gain. Work towards removal of this defect is in progress, and substantial improvement has already been attained.

We think it desirable even at this interim stage to direct attention to the possible existence of this defect as a contributory cause in the reduction of echo amplitude with ground distance reported by Mitra and Rakshit in their paper. It is clearly desirable that this instrumental point should be cleared up in each individual case before a geophysical interpretation of echo amplitudes is looked for.

R. A. WATSON WATT.
L. BAINBRIDGE-BELL.

Radio Research Station,
Slough, Bucks.
April 6.

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[1] *Phil. Mag.*, **15**, 20; 1933.

Action of Quaternary Ammonium Salts on Nerve

EXPERIMENTS similar to those of Fromherz with curare on medullated nerve, referred to by Prof. A. V. Hill in his article on "The Physical Nature of the Nerve Impulse",[1] in NATURE of April 8, have been made with pure quaternary ammonium salts prepared by Dr. H. R. Ing. These have a curare-like action, preventing transmission of excitation from nerve to muscle, but not affecting muscle or medullated nerve directly in the concentration required for paralysis.

A frog's nerve, taken from a gastrocnemius-sciatic preparation which had been 'curarised' in Ringer's solution containing 2 millimols per litre of tetramethyl ammonium iodide or 1 millimol per litre of octyl trimethyl ammonium iodide, was asphyxiated until excitability had disappeared and then for a further hour. When oxygen was readmitted the nerve showed only a transient recovery of action current and this vanished in about half an hour. If a concentration of 2 millimols per litre of octyl trimethyl ammonium iodide or 1 millimol per litre of strychnine methiodide was employed, there was no transient recovery of action current on admission of oxygen. An increased dose of the two drugs first named, or the use of a similar compound of greater molecular weight, abolishes even the temporary return of the action current in oxygen after asphyxiation. A control nerve-muscle preparation left soaking in oxygenated Ringer's solution containing the quaternary ammonium salt was still 'curarised' at the end of the experiment, but when the nerve was cut off and tested the action current showed no diminution. Also, control nerves soaked in Ringer's solution without poisoning and then asphyxiated in the way described showed only a 15–20 per cent decline in action current.

Experiments made in September at the Marine Biological Laboratory, Plymouth, showed that the action current is abolished in the non-medullated nerves of *Maia squinado* by soaking for about a minute in sea water containing less than 1 millimol per litre of quaternary ammonium salt. As with veratrin, the salt can penetrate the non-medullated nerve without asphyxiation.

S. L. COWAN.

Department of Pharmacology,
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April 12.

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[1] NATURE, 131, 501, April 8, 1933.

Further Light on the Schneider Mediumship

LORD CHARLES HOPE is correct in stating (NATURE, April 15, p. 549) that the 'suspect' detected in trickery at Dr. Osty's experiments was 'allowed' to attend every séance at my laboratory, but this was because Rudi Schneider refused point blank to sit without her.

It had been arranged to hold a series of sittings during the summer of 1931, but negotiations broke down because we refused to allow the 'confederate' (a close friend of Rudi's) to accompany him. When we found that Rudi would not visit the Laboratory without his friend, we consented to have her, but—after Dr. Osty's experiences—special precautions were taken to keep her under close observation during the séances.

Although Dr. Osty now admits that he detected Rudi's friend producing the 'phenomena' herself, his report contains no mention of this, and the fact that she was present at any experiment is not recorded in the account prepared for the public.

Stress has been laid on the fact that our cameras caught Mr. Schneider evading control, but so long ago as 1924 Professors Meyer and Przibram of Vienna detected Rudi producing 'telekinetic' movements of objects by means of a freed arm. That he *can* free an arm from the usual tactual control (and without the controllers being aware of the fact) has now been proved by our photographic evidence.

Mr. Schneider has promised to visit us during the coming autumn, when we hope finally to settle the question as to whether he can externalise some 'force' capable of displacing objects at a distance, or of affecting infra-red rays. We want 'Olga' (his trance personality) again to hand round flowers and cigarettes: to play the zither: to place a paper basket over a sitter's head: to give us another 'farewell signature'—all of which 'supernormal' diversions we witnessed at previous experiments.

HARRY PRICE.

13d, Roland Gardens,
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April 21.

Invar

IL n'est pas douteux que les recherches de M. Honda soient fondamentales, et aient apporté de sérieux progrès à nos connaissances sur les alliages de fer avec le nickel, le cobalt et le chrome. Mais je voudrais rectifier une petite erreur dans son exposé, paru dans le numéro de NATURE du 22 avril, 1933, p. 587. M. Honda dit, en effet, qu'on n'a pas pu réaliser un invar ayant une dilatation inférieure à $1{\cdot}2 \times 10^{-6}$. Or, les fils employés en géodésie, et qui ont une très faible dilatation, passant même quelquefois au-dessous de zéro, sont, depuis plus de vingt ans, de fabrication courante. Pour expliquer la faible dilatabilité de l'invar, on s'est fondé sur l'existence réversible de fer α et de fer γ. Des publications importantes sur cette question ont été faites, notamment par F. Osmond, Louis Dumas et Pierre Chevenard. J'y ai fait moi-même plusieurs fois allusion.

CH.-ED. GUILLAUME.

Bureau international des Poids et Mesures,
Sèvres.

Research Items

Patwin and Maidu Cult Origins. A further investigation of the Patwin and Maidu tribes of California was undertaken by Mr. E. M. Loeb in 1931 with the object of adding to information previously obtained relating to the secret society organisation of northern California as it existed prior to 1870 (*Univ. California Pub. American Archæol. and Ethnol.*, 33, No. 2). The main cults of north-central California are local or autogenous units; but the specific traits entering into the cults usually are more widespread than the cults themselves, and therefore have come to north-central California by diffusion, when they have not arisen by a process of disintegration and amalgamation. Tribal initiation was the oldest cult, and its elements (the bullroarer, the tribal mark, the death and resurrection ceremony, and the representation of spirits or ghosts) probably were brought in by the American Indians on their entrance to the New World. Some of these were adopted by later cults; others lost, as the bullroarer among the Patwin-Maidu. 'Ghosts' may be split into three sub-traits—clowns, running spirits, and representatives of the dead. Of these, running spirits alone are indigenous to north-central California, while clowns originated in the south-west or in Mexico. Human representation of the dead occurs in Lower California, and on the Colorado. It is possible that the annual mourning ceremony was located in Mexico. The use of the scratching stick and sucking tube points to the origin of the initiation ceremony at one point in the world. They occur in both North and South America as well as in the Old World. While the kuksu cult has affinities with the south, the hesi cult comes from the north, bringing with it private ownership of dances and dance dress, and probably bear doctors, bear dances and bear propitiation. The kernel of the hesi cult may lie in first-fruit, and especially acorn, rites.

Pleistocene Dating of Gafsa Hills, Tunisia. M. R. Vaufrey has now published (*Rév. Géog. Phys.*, 5, fasc. 3) the communication presented to the Prehistoric Congress in London in August last, in which he brought forward evidence derived from the discovery of palæolithic implements *in situ* making it possible to fix, within certain limits, the date of the formation of the hills in the oasis of Gafsa, Tunisia. The low hills of the oasis, following the general conformation of southern Tunisia, run from north-east to south-west. It had been noted previously that the alluvial deposits, forming a conglomerate, of which the hills are composed, are tilted, the lamination being exposed by erosion on the north side. A considerable number of stone implements have been found on one of the hills, "la colline du signal", by previous investigators, notably Schweinfurth (1907) and de Morgan (1910), the former classifying the earlier implements elaborately according to the eolithic nomenclature of his day. One of the objects of M. Vaufrey's investigations, therefore, was to discover implements *in situ* with the view of establishing their exact relation to the tilting. Implements were found at three points in the tilted strata, the latest in type being an evolved Acheulean. On the other hand, in the horizontal strata of the alluvial deposits of later date which lie at the foot of the hills and have not been subjected to the folding to which the formation of the hills was due, he found a Mousterian implement, a typical Levallois flake. On this evidence he concludes that it is justifiable to fix the date of the formation of the hills at the interval between Acheulean and Mousterian, say, at the end of the Riss-Würm glaciation or at the very beginning of the last glaciation of the ice age. As he says in conclusion, this is the best example known of folding which can be attributed with certainty to the Pleistocene.

Internal Ear of Amphibia. C. Guareschi (*Mem. Roy. Accad. d'Italia, Classe Sci. Fis. Mat. Naturali*, vol. 3, pp. 147, 1932) records in detail the results of his experimental investigations on the internal ear of Amphibia, both Urodela and Anura. Into whatever region of an embryo of the same species and the same age the developing ear is transplanted, it will differentiate into an internal ear and the differentiation is independent of the relations with neighbouring organs and of the innervation. A part of the ear rudiment when transplanted is not capable of giving rise to the structures potentially contained in the other part. In the destruction which inevitably takes place in xenoplastic transplantations, after the absorption of the yolk, the otocyst presents a greater resistance than the eye, and its parts show a differential susceptibility resulting in the more rapid destruction of the sensitive area. Two otocysts may be made to fuse and the resultant is provided with all the structures contained potentially in the two rudiments. There exists an independence between the development of the cristæ and the maculæ.

Chromosomes of Amphibians and Fishes. In a series of five papers on the chromosomes of amphibians, Dr. Shigemori Iriki (*Sci. Rep. Tokyo Bunrika Daigaku*, vol. 1, p. 61) has added considerably to our knowledge of the cytology of this group, especially as regards the Japanese species. In two species of *Rana* he finds the diploid chromosome number to be 26, confirming his earlier count. In spermatogenesis he finds a V-shaped body which he interprets as a pair of X-chromosomes, and concludes that probably in all Anura the female is heterogametic for sex. He shows a spiral structure in the X-chromosomes of the male *Hyla arborea japonica*. Among Urodela, in *Diemyctylus pyrrhogaster*, $2n = 24$, while in *Megalobatrachus japonicus*, $2n = 64$. No differentiated sex chromosomes were found in urodelans, but it is concluded that here also the males are probably of the XX type. In fishes, too, attempts to differentiate sex chromosomes have been unsuccessful, but there is clear genetic evidence for an XY pair in the males of *Lebistes* and that in *Aplocheilus* also the males are genetically heterogametic for sex. On the other hand, in *Platypœcilus* the evidence is decisive that the female is the heterogametic sex.

Insect Pollinators of Orchard Trees. The sterility of fruit trees is a widespread evil. One sees many unproductive trees, especially in small orchards, in all parts of Great Britain. Many of the factors which affect sterility, such as genetic constitution, the nutrition of the tree and the influence of the grafted stock, are being investigated in several research stations. Mr. G. Fox Wilson has studied the actual mechanism of pollination as effected by insects. ("Pollination in Orchards", *J. Roy. Hort. Soc.*, 58, pt. 1, 125–138, Feb. 1933). He describes many species of insect visitors to hardy fruit trees, and, in the paper under review, outlines the pollinating habits of some of them. Many valuable suggestions are given for the planning of the orchard so that maximum pollination may result. It is shown, for example, that humble bees will not visit currants and gooseberries planted in the neighbourhood of cherries. Many of the wild species of pollinating insects visit the edges, but not the centre of a large orchard, and it is recommended for the fruit-grower to make quite sure of fertilisation by placing hives of bees here and there amongst the trees.

Nitrogenous Manuring of Legumes. The question of using nitrogenous fertilisers on leguminous crops like peas, beans and lucerne, has been much discussed of late on the Continent. What has generally been considered the best practice in Great Britain and elsewhere is to restrict their use to a young crop, the growth of which needs accelerating; otherwise they are uneconomic. The opinion is, however, fairly widespread that fertilisers containing readily assimilable nitrogen are distinctly harmful to the nitrogen-fixing activities of the nodule bacteria; and it was this contention that induced H. Burgevin, director of the Station Centrale d'Agronomie at Versailles, to investigate the question (*C. R. Acad. Sci.*, Paris, **196**, 441–3; 1933; and *C. R. Acad. d'Agric. de France*, **19**, No. 6; 1933). Soya beans were grown in naturally sterile soil contained in pots, one series being inoculated with a culture of *B. radicicola* specific to the soya bean, and the other left sterile. In addition to a basal dressing of phosphate, potash and chalk, inorganic nitrogen in the form of nitrates and ammoniacal salts was applied in dressings equivalent to 0, 45, 90, and 135 lb. of nitrogen per acre (or to 0, 2, 4, and 6 cwt. per acre of sulphate of ammonia); and it was found that the plants in the sterile soil that had received nitrogen developed proportionately to the amount of nitrogen applied, although their leaves turned perceptibly yellow. In every case the inoculated plants did best, and not only did they not suffer from the presence of the added nitrogen, but also they utilised it to advantage, as well as the nitrogen fixed by the bacteria. Even the highest applications of added nitrogen did not injure the nitrogen-fixing power of the nodule bacteria; so that the use of small dressings of nitrogenous fertilisers for legumes, to assist their early growth, if necessary, appears fully justified.

Canadian Minerals of the Rare Elements. H. V. Ellsworth has prepared an invaluable and highly interesting report on the rare-element minerals of Canada (*Econ. Ser.* No. 11, Geol. Sur. Canada, 1932, pp. 272). The elements dealt with are uranium and thorium and their associated transformation products; tantalum; columbium; zirconium; hafnium; beryllium; lithium; rubidium; and cæsium; all of which occur as constituents of minerals found in pegmatites. Chapters on these are followed by others devoted to the geological setting of the minerals and their occurrences in Canada, and to radioactivity and radioactive minerals as indicators of geological age. The report concludes with a record of all the chemical analyses of Canadian rare-earth minerals that have so far been made. One major object of the survey has been to study all the known occurrences with the view of ascertaining the feasibility of commercial exploitation, and determining the most favourable indications that might be useful to the prospector in searching for these minerals. Another important consideration was concerned with the possibility of correlating igneous rocks, the age relationships of which could not be determined by ordinary geological methods. The Besner uraninite, for example, which occurs in a pegmatite cutting granite-gneiss of probably Killarney age, has a lead ratio of 0·11, whereas many of the pegmatites of the Laurentian-Grenville area carry uraninites having an average lead ratio of 0·155. The radioactive method thus supports the probability that some of the granites are of Killarnean age and provides a means for distinguishing them from those of Laurentian age.

Everyday Photometry with Photoelectric Cells. Johann Heinrich Lambert, one of the pioneers of illuminating engineering, in his book "Photometria" (Augsburg, 1760) regrets that there is no instrument analogous to a thermometer which might be used for the direct measurement of illumination. In his paper on photometry read recently to the Illuminating Engineering Society, Dr. J. W. T. Walsh shows that such a photometer has now been invented, although not yet quite fully developed. There are three classes of photoelectric cells used with this type of photometer: the Elster-Geitel, the selenium and the photovoltaic or rectifier cell. The ideal photoelectric cell would provide a current which was strictly proportional to the illumination at the cell for all values of this illumination, no matter what the colour of the light, its angle of incidence or state of polarisation. In addition, the strength of the current should always be the same for the same illumination. Unfortunately, none of these requirements is satisfied in any of the cells available for practical work. In the case of the gas-filled Elster-Geitel cell and the selenium cell, proportionality between current and illumination can only be assumed over a limited range. With other types it is possible by careful design to obtain a close approximation to the desired linear law. In some types the error does not exceed two per cent. Colour sensitivity presents a difficult problem. No cell responds to the various wavelengths in the visible spectrum in precisely the same way as the human eye does. Colour filters have been used to correct this but they produce a serious loss of sensitivity. Photoelectric methods, therefore, can only be employed in high precision work when the lights to be compared have almost exactly the same spectral composition.

Fatigue-Resisting Properties of Aluminium Alloys at High Temperatures. In a paper read at the March meeting of the Institute of Metals, Mr. J. W. Cuthbertson extended the study of the rapid determination of the fatigue limit by his modification of the load-deflection test to aluminium and its alloys. In comparing the results with those obtained by the normal long-time endurance test, it is shown that the average of the results is ± 7·5 tons per sq. in. in the latter case against ± 7·9 with the load-deflection test. The extreme range of values obtained in the two cases was ± 2·0–10·6 and ± 2·1–10·7 tons per sq. in. respectively. The agreement is thus quite good. In the author's opinion, if 10 per cent be deducted from the results given by his rapid test, the fatigue limits so found will be well on the safe side and agree satisfactorily with those of the endurance method. The materials examined consisted of commercial aluminium, duralumin, 'Y' alloy and the complex alloy known generally as 'R.R. 56'. At temperatures up to 250° C., the fall in the fatigue limits of the alloys is not great; duralumin, for example, which has a fatigue limit at room temperatures of ± 9·2 tons per sq. in., having at 220° C. a limit of ± 8·2 tons. Even at 300° C. the reduction is not excessive, but above about that temperature the fall becomes distinctly more rapid. Some most interesting observations are made on the 'creep' of these alloys at high temperatures under alternating stress. Under a constant skin stress of ± 6·5 tons per sq. in., all these alloys show just above 300° C. a marked increase in the rate of 'creep'; this, therefore, represents the maximum temperature to which load-deflection tests can be regarded as reliable.

Measurement of Volatility Range of Lubricating Oils. Messrs. R. N. J. Saal and C. G. Verver have given considerable attention to this matter and brought their results to the notice of the Institution of Petroleum Technologists at its meeting on April 11, 1933. The authors conclude that there are serious objections to an analytical vacuum distillation for these higher boiling-point products in that lubricating oils of various origins show signs of decomposition at about 320° C. and at 375° C. cracking is noticeable. Vacuum distillation methods render the use of direct heating essential, which entails a variable temperature; indirect heating is a condition which the authors claim is a *sine qua non*. The usual type of vacuum distillation is necessarily more or less arbitrary, giving results depending upon the existing degree of dephlegmation. Rigid standardisation is essential if reproducible results are to be obtained. Vacuum distillation also involves complicated apparatus and admittedly requires much attention and manipulative skill. To obviate these difficulties, steam distillation at a constant temperature is proposed and the authors gave a good account of the apparatus, procedure and results obtained by this method. They claim to have eliminated all the above objections to vacuum distillation by regulating conditions of test in such a way that there is substantially complete saturation of the steam with oil vapour and no dephlegmation occurs, and that their process of indirect heating by means of a bath of high specific conductivity is eminently satisfactory. It would seem that, as a result of their work, the measuring of the volatility range of lubricating oils and other high boiling-point petroleum fractions is no longer a purely empirical procedure, but a highly refined method giving concordant and comparable results.

Astronomical Topics

Comets. The periodic comet Giacobini-Zinner was detected by Prof. R. Schorr at Bergedorf on April 23 at $1^{h}\ 56{\cdot}4^{m}$ U.T., in R.A. $21^{h}\ 34^{m}\ 4^{s}$, N. Decl. 15° 18′, Mag. 15. Being the third discovery of the year, it is 1933 *c*. The deduced time of perihelion is about July 15·4. The ephemeris in the Handbook of the British Astronomical Association for 1933 will suffice to follow it, if three-quarters of the given corrections for *T* one day later be applied with reversed signs.

This is the fourth observed apparition of this comet; it was seen in 1900, 1913, and 1926. It is of special interest from the fact that its orbit makes a near approach to that of the earth; a shower of the meteors belonging to its system should be looked for in October next. The earth passes the comet's descending node about 8 p.m. on October 9.

Geddes's comet remains an easy object, and has a tail ½° in length. An ephemeris for the whole year is in the B.A.A. Handbook.

Mr. J. C. Du Pui of Utrecht has published a very careful study of the orbit of comet 1917 III, discovered by Prof. M. Wolf on April 3, 1916, and observed for twenty-two months. The systematic errors of the observers are determined, and the positions and proper motions of the comparison stars deduced from all available sources. The following are the elements:

T 1917 June 16·5694 G.M.T.

$$\left.\begin{array}{ll}\omega & 120^\circ\ 37'\ 21{\cdot}4''\\ \Omega & 183\ \ 17\ \ 44{\cdot}3\\ i & 25\ \ 40\ \ 10{\cdot}8\end{array}\right\}\ 1917{\cdot}0$$

$\log q$ 0·226974

Period 193,100 years.

There is clear evidence of departure from a parabola. The aphelion distance is 6,682 units.

Sunspot Areas and Numbers for 1932. A résumé of the solar activity for the year 1932 appears in the February issue of the *Monthly Notices of the Royal Astronomical Society*. The mean daily area of spots (corrected for foreshortening), derived from solar photographs measured at Greenwich, was about 165 millionths of the sun's hemisphere as compared with 275 millionths for the previous year. The number of spots decreased in about the same ratio. Three groups of sunspots exceeded 500 millionths in area, the respective times of central meridian passage being April 25·4, November 16·2, December 13·0. A number of smaller groups, however, showed activity when examined in hydrogen light (Hα). All forms of prominence activity showed a considerable decrease below the 1931 values. It would seem that the solar minimum will be reached very shortly, but as yet no definite signs have appeared of high latitude sunspots which indicate the final phase of the completed 11-year cycle and the commencement of the new.

In *Astronomische Mitteilungen* (No. 130), the Director of the Federal Observatory, Zurich, publishes the relative sunspot numbers for 1932 derived from more than fifty collaborating observers. The mean number, *R*, for the year is 11·1 as compared with 21·2 for the previous year.

The Variable Star Delta Orionis. It has for some time been known that this star, the top star of the belt, is an eclipsing variable star with a very small light-range. Dr. J. Plassmann (*Astr. Nach.* No. 5931) now discusses the light-changes from 1881 to 1932; he finds evidence of small secular changes in the light-curve. The highest maxima occurred in 1913 and 1914, the lowest minima in 1895 and 1896, the extreme range between these being 2½ of his steps. He does not give the equivalent in magnitude. He notes that recent observations indicate a diminution of the epoch in the published elements by about a tenth of a day, also that the interval from minimum to maximum is about a day, and that three minor waves show themselves on the light-curve, somewhat resembling those found in stars of the Delta-Cephei type. He promises fuller details in a later paper.

Amino-Acids, Proteins and Proteolytic Enzymes*

By Prof. Max Bergmann, University of Dresden

I

APPROXIMATELY twenty-five amino-acids are generally recognised at the present time as constituents of proteins. It is usually assumed that the amino-acids are linked together in the protein molecule by condensation of the carboxyl group of one amino-acid with the amino group of the next with elimination of water to form an amide or peptide linkage; of such linkages the protein molecule contains very large numbers.

It has been calculated that the number of known amino-acids is fully sufficient to account, by variations in the order in which they are combined, for the existence not only of the clearly differentiated fundamental types of protein but also of the enormous number of individual proteins which are required by biological and immunological theory.

Such an arithmetical calculation is, however, no longer satisfying; we desire to know more precisely what is the influence of the nature of the component amino-acids and of the order in which the latter are combined upon the properties of the protein as a whole. One might anticipate, for example, that the action of proteolytic enzymes on a given peptide linkage would be determined by the properties and arrangement of the amino-acids of which the peptide is built up; it is impossible, however, to regard the properties of a protein as a simple summation of those of its constituent amino-acids.

The remarkable stability of the amino-acids is usually ascribed to their zwitterionic nature, from which results their capacity to form internal salts; the immediate neighbourhood of oppositely charged ionised groups must indeed exercise a dominating influence on the behaviour of the amino-acids. It is therefore to be expected that we shall modify the properties of the amino-acids, and in particular their chemical behaviour, if we combine the ionisable groups in peptide linkage and thereby alter their mutual electro-chemical effects.

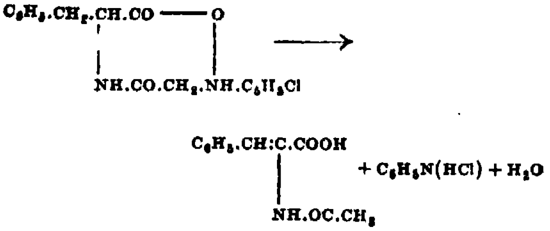
The outstanding problem of modern protein chemistry is thus twofold in nature: What effect does combination in peptide linkage exercise upon the different amino-acids? And how is the nature of the peptide linkage itself influenced by the character of the amino-acids which take part in its formation? Although work on both aspects of this question is still in an elementary stage, a number of facts have already been revealed which are significant both from a chemical and a biochemical point of view.

In the first place, I should like to show by a few examples that we can reveal a new series of chemical properties of the amino-acids if we convert the latter, by simple acylation of the amino group, into a condition analogous with that in which they exist in peptides. The simplest case is that of acetylation; if we acetylate the amino group of an optically active amino-acid, we find that contact with a small amount of acetic anhydride at the ordinary temperature is sufficient to catalyse the rapid racemisation of the acetylated amino-acid[1]. The striking ease with which this racemisation occurs must be ascribed to an intermediate enolisation:

$$\mathrm{R.CH(NH.OC.CH_3).COOH} \longrightarrow \mathrm{R.C.(NH.OC.CH_3){:}C(OH)_2}$$

In this reaction, therefore, different parts of the same molecule which are not directly connected with one another, namely, the peptide linkage and the α-hydrogen atom, exhibit a definite mutual influence. A similar mutual influence but in the opposite sense is shown by the complete absence of racemisation when chloroacetylated amino-acids are treated with acetic anhydride under the same conditions. Such remote actions of different parts of the molecule upon one another are of special importance in enzymic processes; their investigation in model experiments makes it possible to expose properties of the amino-acids and peptides which would otherwise remain hidden and to draw conclusions therefrom as to the processes which these compounds may undergo in metabolism.

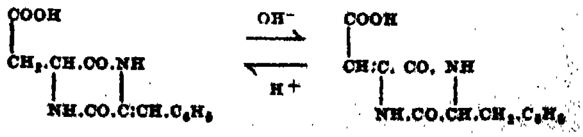
A particularly surprising example is provided by pyridylacetylphenylalanine, which is a dipeptide closely related to glycylphenylalanine; this compound, when treated with acetic anhydride and pyridine at the ordinary temperature, is converted into acetyldehydrophenylalanine with liberation of pyridine and water:



$$\begin{array}{l}\mathrm{C_6H_5.CH_2.CH.CO — O}\\ \qquad\qquad\;\; | \qquad\quad\;\; | \\ \qquad\qquad\;\; \mathrm{NH.CO.CH_2.NH.C_5H_5Cl}\end{array} \longrightarrow \begin{array}{l}\mathrm{C_6H_5.CH{:}C.COOH}\\ \qquad\qquad\;\; | \\ \qquad\qquad\;\; \mathrm{NH.OC.CH_3}\end{array} + \mathrm{C_5H_5N(HCl)} + \mathrm{H_2O}$$

The phenylalanine is thus dehydrogenated and the liberated hydrogen is employed to hydrogenate the pyridylacetic acid to pyridine and acetic acid[2]. Here, therefore, we have in one half of the molecule the first example of the direct transformation of an amino-acid into a fatty acid, accompanied by simultaneous unsaturation of the amino-acid constituting the other half to give a dehydroamino-acid. According to the theory of Wieland, a dehydrogenation of this character would require the activation of the amino-acid and the presence of an acceptor for the liberated hydrogen; the activation of the phenylalanine is brought about by its combination in peptide linkage with transient formation of a cyclic anhydropeptide whilst the pyridylacetic acid residue serves as hydrogen acceptor.

According to the prevailing view, the biological degradation of an amino-acid to a keto-acid begins with a dehydrogenation, and conversely the biological synthesis of an amino-acid from a keto-acid ends with a hydrogenation. It is possible to combine examples of both these processes in a single experiment[3] *in vitro*. The introduction of the dehydrophenylalanyl residue into aspartic acid yields a cyclic anhydride; dissolution of the latter in normal sodium hydroxide causes transference of two hydrogen atoms from the aspartic acid to the dehydrophenylalanine:



$$\begin{array}{l}\mathrm{COOH}\\ |\\ \mathrm{CH_2.CH.CO.NH}\\ \qquad | \qquad\quad |\\ \quad\;\; \mathrm{NH.CO.C{:}CH.C_6H_5}\end{array} \underset{\mathrm{H^+}}{\overset{\mathrm{OH^-}}{\rightleftharpoons}} \begin{array}{l}\mathrm{COOH}\\ |\\ \mathrm{CH{:}C.\,CO.\,NH}\\ \qquad | \qquad\quad |\\ \quad\;\; \mathrm{NH.CO.CH.CH_2.C_6H_5}\end{array}$$

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* Substance of three lectures on "The Chemistry of Proteins" delivered at University College Hospital Medical School, London, on January 20, 23 and 24, 1933.

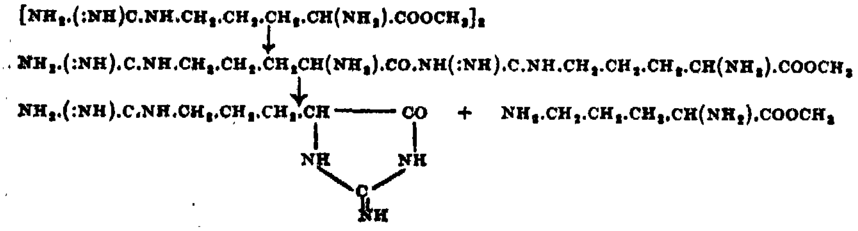
whilst in acid solution the reverse transformation may be accomplished. In the first case, therefore, degradation of the aspartic acid has begun and in doing so has completed the synthesis of phenylalanine from its unsaturated precursor. These experiments show that the hydrogenation: dehydrogenation potentials of the individual amino-acids are different; in metabolism there must indeed exist among the amino-acids a constant competition for hydrogen, the outcome of which will vary with circumstances.

By similar facile reactions it is possible to convert serine with elimination of water and cysteine with elimination of hydrogen sulphide into dehydroalanine and thence into pyruvic acid; serine and cysteine are thus brought into genetic relationship with the simple amino-acids and their nitrogen-free transformation products[4].

Of all the amino-acids, the most widely distributed is arginine, which occupies a special position also by virtue of its guanido group. Arginine can be converted into a peculiarly reactive condition by complete acetylation with simultaneous elimination of water. The triacetylanhydroarginine so formed has a strong tendency, in presence of water and of hydroxy or amino compounds in general, to lose the cyanamide residue, which is itself transferred to the accompanying compound; a mixture of sarcosine with triacetylanhydroarginine, for example, yields creatine together with a derivative of ornithine[5].

The latter result is of interest in relation to two physiological processes: (1) the creatine synthesis *in vitro* shows how creatine-nitrogen can be derived from two different amino-acids; it is probable that in the course of metabolism creatine is formed in a similar manner from two amino-acids of which one is arginine; (2) the conversion of arginine into ornithine by the enzyme arginase demands that the latter be attached to the arginine molecule in such a manner that the arginine is activated and hydrolysed to ornithine even by cold water; this process is imitated by the ease of hydrolysis of triacetylanhydroarginine to acetyl derivatives of ornithine and of urea.

There remains to be discussed yet another noteworthy transformation of arginine which has long caused confusion in the literature; if arginine be esterified with methyl alcohol, the resulting ester passes spontaneously into ornithine methyl ester and *bis*guanidovaleric acid:



$$[NH_2.(:NH)C.NH.CH_2.CH_2.CH_2.CH(NH_2).COOCH_3]_2$$

$$\downarrow$$

$$NH_2.(:NH).C.NH.CH_2.CH_2.CH_2CH(NH_2).CO.NH(:NH).C.NH.CH_2.CH_2.CH_2.CH(NH_2).COOCH_3$$

$$\downarrow$$

$$NH_2.(:NH).C.NH.CH_2.CH_2.CH_2.CH — CO + NH_2.CH_2.CH_2.CH_2.CH(NH_2).COOCH_3$$

This reaction must occur in the metabolism of those shell-fish from which Kutscher, Ackermann and Flössner[6] have isolated arcaine (1:4-diguanidobutane).

The few examples which have been given indicate what an abundance of unsuspected reactions can be elicited from the amino-acids if their zwitterionic character is destroyed by combination in peptide linkage. Almost every amino-acid is affected differently in this respect; conversely, therefore, every amino-acid must have a different influence on the peptide bond.

In order to be able to study this influence on representative material, it is necessary to prepare different peptide combinations artificially and to test the action of enzymes upon them. To carry this task to its logical conclusion would be a formidable undertaking; fortunately, however, it suffices to prepare peptides containing representative members of the most important types of amino-acids.

Chemists have striven for more than thirty years to discover suitable methods for the synthesis of peptides containing the more complex amino-acids, but until recently only isolated successes have been obtained[7]. Quite lately, however, a general method has been developed[8], the essential feature being the nature of the acid residue used to block the amino group.

The acid chloride of benzylcarbonic acid is readily obtained by the interaction of benzyl alcohol and phosgene and can be condensed with any amino-acid to yield the corresponding benzylcarbonato derivative. The benzylcarbonato-amino-acids are beautifully crystalline substances which can be easily transformed into their acid chlorides or azides and these in turn can be condensed with other amino-acids to yield benzylcarbonatopeptides. Most important, however, is the fact that the benzylcarbonato residue can be split off without the employment of a hydrolytic agent, so that it can be eliminated from a benzylcarbonatopeptide without danger of scission of the peptide bond. The removal of the benzylcarbonato residue is accomplished by catalytic hydrogenation in presence of palladium black, under which conditions the benzyl residue is eliminated as toluene and the resulting carboxy-amino derivative loses carbon dioxide spontaneously to give the free peptide. The last step of the process proceeds not only with ease but also in most cases almost quantitatively:

$$C_6H_5.CH_2.O.CO.Cl + NH_2.CHR.COOH \longrightarrow$$
$$C_6H_5.CH_2.O.CO.NH.CH.R.COOH$$

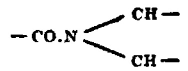
$$C_6H_5.CH_2.O.CO.NH.CHR.COCl + NH_2.CHR^1.COOH \longrightarrow$$
$$C_6H_5.CH_2.O.CO.NH.CHR.CO.NH.CH.R^1.COOH$$

$$C_6H_5.CH.O.CO.NH.CHR.CO.NH.CHR^1.COOH + H_2 \longrightarrow$$
$$NH_2.CHR.CO.NH.CHR^1.COOH + C_6H_5.CH_3 + CO_2$$

A further advantage of the benzylcarbonato method is that it involves no risk of racemisation; with its aid, in fact, the preparation of many optically active peptides, which have hitherto been practically inaccessible, becomes a trivial matter.

A complete picture of the possibilities of the new method of peptide synthesis cannot be given here, but it is possible to indicate some of the new lines of research which it opens up; in particular it may be of interest to mention certain hitherto unobtainable peptides which have been prepared by the benzylcarbonato method and to describe their behaviour towards enzymes.

As representative peptides we may mention: d-*Glutamyl*-d-*glutamic acid*, a substance with three carboxyl groups and one amino group and therefore strongly acidic in character; d-*Lysyl*-d-*glutamic acid*, the first example of a dipeptide of a diamino-acid and an amino-dicarboxylic acid ; d-*Lysyl*-l-*histidine*, a dipeptide of two strongly basic amino-acids ; l-*Asparagyl*-l-*tyrosine* and d-*glutamyl*-l-*tyrosine*, two closely related dipeptides which, however, differ remarkably in their behaviour towards enzymes (see below) ; l-*Tyrosyl*-l-*tyrosine*, a dipeptide containing two phenolic groups ; *Glycyl*-l-*proline* and d-*alanyl*-l-*proline*, which occupy a distinctive position owing to the nature of the peptide linkage :—



$$-\mathrm{CO.N}\begin{matrix}\nearrow \mathrm{CH}-\\ \searrow \mathrm{CH}-\end{matrix}$$

For comparison with these proline peptides another dipeptide in which the nitrogen of the peptide linkage is tertiary in character, namely, glycylsarcosine, has been prepared.

In the following table, the behaviour of these dipeptides is shown towards dipeptidase, towards aminopolypeptidase, and towards trypsin (that is, a mixture of proteinase and carboxypolypeptidase) :

	Dipeptidase.	Aminopolypeptidase.	Trypsin (Carboxypolypeptidase + proteinase).
d-Glutamyl-*d*-glutamic acid	+ +	—	—
d-Lysyl-*d*-glutamic acid	+	—	—
d-Lysylglycine	+ +	—	—
d-Lysyl-*l*-histidine	+ +	—	—
l-Asparagyl-*l*-tyrosine	—	—	—
d-Glutamyl-*l*-tyrosine	+ +	—	—
l-Tyrosyl-*l*-tyrosine	+ +	—	+
d-Tyrosyl-*d*-arginine	—	—	+
Glycyl-*l*-proline	—	+ +	—
d-Alanyl-*l*-proline	—	+ +	—
Glycylsarcosine	—	0	—

With glutamylglutamic acid the result is as one would expect ; this dipeptide, in spite of its strongly acidic character, is hydrolysed by dipeptidase after suitable buffering.

Lysylglutamic acid on the other hand is attacked only with difficulty by dipeptidase ; lysylglycine is readily hydrolysed by this enzyme and the same is true of the strongly basic lysylhistidine. These examples show that the preponderance of acidic or of basic groups does not interfere with dipeptidase action, since the most strongly acidic and most strongly basic dipeptides are both attacked by the enzyme. Surprising differences of behaviour between closely related compounds are exemplified by asparagyl- and glutamyl-tyrosine, of which the first is resistant to all intestinal proteolytic enzymes whilst the second is readily hydrolysed by dipeptidase.

l-Tyrosyl-*l*-tyrosine presents an anomaly inasmuch as it is hydrolysed not only by dipeptidase but also by trypsin, whilst *d*-tyrosyl-*d*-arginine is actually not affected by dipeptidase but is hydrolysed by carboxypolypeptidase.

The behaviour of the proline peptides towards proteolytic enzymes is especially illuminating. Neither glycylproline nor alanylproline is attacked by dipeptidase whilst both are hydrolysed by aminopolypeptidase ; here therefore we have two dipeptides for which dipeptidase is not the appropriate enzyme, and it becomes clear that the accepted definitions of dipeptidase and aminopolypeptidase are unsatisfactory. More important still is the conclusion which emerges from the experiments with the proline peptides that 'dipeptidase' can only attack a normal peptide linkage (.CONH.), whilst at least one constituent of 'aminopolypeptidase' can hydrolyse a peptide linkage in which the nitrogen atom is tertiary. This view is confirmed by the fact that glycylsarcosine is also resistant towards dipeptidase.

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West Regional Broadcasting Station in Great Britain

IT will be remembered that a few years ago the British Broadcasting Corporation engineers evolved what is known as the 'regional scheme' for covering Great Britain with an adequate broadcasting service providing alternative programmes of approximately the same strength. According to this scheme, each part of the country is catered for by a twin-wave transmitting station radiating both a national broadcasting programme and a regional programme specially arranged for the area under consideration. The fourth station of this type is now practically complete and experimental programme transmissions were commenced on April 24. The following details of this West Regional Station are taken from an article in *World Radio* of April 21.

The station has been built near the Somerset coast at Washford Cross, two miles from Watchet and six miles east of Minehead. The site was chosen as being suitable for the provision of a good service to the important centres of population in the west of England and to South Wales in addition. The design of the station follows closely the general arrangement of the regional stations, and includes some of the modifications recently introduced at the Scottish Regional Station. Each of the two aerials employed is of the 'umbrella' type supported by an insulated lattice steel mast 500 ft. high. These two masts are illuminated at night by aircraft warning lights, which are fed through filter circuits to prevent the flow of high-frequency current in the lamp leads.

The whole of the electrical power required is generated locally by Diesel engine plant and sufficient fuel oil is stored for three months operation. For the various electrical supplies required, three of each type of motor-generator set are installed ; one of these is in use on each transmitter, while one is spare. The national and regional transmitters are similar and of a standardised type of construction comprising five separate units. Modulation is carried out at an early stage following the drive oscillator. Two stages of high-power amplification follow, while the fifth unit contains the tuning and coupling circuits for the final power stage. In each stage it is possible to switch in a spare valve without interrupting the power supply. A studio for testing purposes is fitted up in the station buildings, although the programmes will normally emanate from the

Cardiff studios. Entirely new studio premises at Bristol are now in course of erection.

The regional transmitter radiates on a wave-length of 309·9 metres, while the national programme is on 261·6 metres. The latter wave-length is already in use by the London national transmitter, and equipment is being installed by means of which the two sets may be exactly synchronised. The new service from this station will be introduced gradually in order to give listeners every opportunity of becoming accustomed to it, and of making any necessary modifications to their receivers so that they may take full advantage of the improved service.

University and Educational Intelligence

CAMBRIDGE.—Dr. M. Dixon has been appointed to the University lectureship in biochemistry, established in connexion with the scheme for the employment of the Rockefeller benefaction, and Dr. E. G. Holmes has been appointed to the University lectureship vacated by Dr. Dixon.

A. D. Thackeray, scholar of King's College, has been elected to the Sheepshanks exhibition.

LEEDS.—At the opening ceremony on April 25 of the Algernon Firth Pathological Institute, it was stated that the new building could not be brought fully into use owing to the lack of funds to equip the Museum which is essential to pathological teaching and research. Mr. Charles Ratcliffe Brotherton promptly offered £1,000, which will permit of the equipment of the Museum in a manner appropriate both to the fine architectural character of the room and to the importance of the work.

The West Yorkshire Coal Owners' Association has decided to renew its annual subscription of £1,000 to the Mining Department for a further period of seven years.

An offer by Mr. Bernard Scattergood to present to the University a transit theodolite for the Observatory has been gratefully accepted.

WALES.—The degree of D.Sc. has been awarded to Dr. Alan Edwin Bradfield, for research in the Department of Chemistry, to Miss Emily Dix, for research in the Department of Geology, and to Mr. Frederick Daniel Smith, for research in the Department of Physics.

THE University of Bristol in its report for 1931–32 makes a special appeal for the endowment of open scholarships, pointing out that at no time in the last hundred years have so many citizens suffered so severely in taxation and diminution of income and consequent inability to afford to pay for university education for their sons and daughters. Notwithstanding the national financial stringency, the University succeeded in keeping its expenditure within its income and there was no falling off in the number of its students (day 973, evening 340). Extra-mural work continued to make satisfactory progress. Among new developments mentioned are the growth of confidence of farmers, fruit growers, market gardeners, willow growers and cider and canning industrialists in the value of the University's research and advisory work, the wide utilisation of the recently organised veterinary advisory service and the establishment of a special section to deal with poultry diseases. The Italian Government placed the services of Dr. Benvenuto Cellini at the disposal of the University for the session to encourage the revival of the study of Italian, which has been re-instated as a subject for the Intermediate Examination. Appended to the report is a list of 176 publications by members of the staff, chiefly those of the departments of science, pure and applied. It is announced that the Department of Zoology is to be re-organised and a professor appointed.

Calendar of Nature Topics

Third 'Buchan Cold Spell'. The Ice Saints

May 9–14. The period May 9–14, selected by Dr. A. Buchan as the third of his six annual cold spells, includes the three days of St. Mamertius, St. Pancras and St. Gervais, May 11–13, who are associated with May frosts in the folk-lore of a large part of Europe and are generally known as the 'Ice Saints'. This supposed cold spell has been attributed to a monsoon-like inflow of cold winds from the north, caused by the rapid warming-up of Central Europe in spring, and also to the obstruction of the sun's rays by a swarm of meteors. Another legend associates the cold spell with May 17–19, the latter being St. Dunstan's Day. There are frequently large fluctuations of temperature during May, and it is highly probable that a cold spell will occur some time during the month. During the present century, Buchan's period has frequently been marked by a drop of temperature in London, but from 1871 to 1900 it was generally warm, and on the whole there is no definite bias in favour of low temperatures at this time.

Breeding of Pearl Oysters coincident with Full Moon

Two additions to the records of the association of breeding with the state of the moon, were made by the Great Barrier Reef Expedition of 1928–29. The workers, stationed at Low Reef off the Coast of Queensland, found that the only pearl oyster which grew upon their island, the 'black-lip', had, like the larger 'gold-lip' which furnishes the greatest supply of mother-of-pearl, two breeding periods in the year, at the time of full-moon in May and in November. The second case, that of the madrepore coral *Pocillopora*, was described by Prof. T. A. Stephenson in NATURE of April 29, p. 622.

Eels—an Early Hypothesis

"Their manner of breeding is very uncertaine and unknowne, but undoubtedly they are bred in the brackish or seawater: and at the first full Moone in May they begin to come into all great rivers, and out of great rivers into lesser rivers, and out of those lesser rivers into all small brookes, rils, and running waters, continually against the streame all the beginning of Sommer. . . . I know that some holde opinion that they breed of the May deaw, for proofe whereof they say if you cut up two turfes of grass in a May morning and clap the grassie sides of those turfes together and so lay them in a river, you shall the next day find small young Eeles between the sayd turfes: and so you shall indeede. . . . The reason is, at that time of the yeare that river being full of such young Eeles, they will creepe into every thing that is sweete and pleasant." (John Taverner, 1600.)

Sun-Fish in British Waters

May is the earliest month in which the sun-fish (*Orthagoriscus mola*) has been recorded in British waters, but the number of records rises throughout the summer to a maximum in September. The sun-fish is an inhabitant of the warmer parts of the open ocean and its appearance in British waters is due partly to a process of drifting in the great Atlantic current which washes our western and north-western shores, for the sun-fish appears to have limited swimming activity (see Calendar, January 7). But from an analysis of many records, Prof. D'Arcy Thompson suggests another factor in the appearance of the sun-fish in northern waters (*Scot. Nat.*, 1918, p. 46). The leptocephalus larvæ of the fresh-water eel have been found, often in multitudes, in its stomach, and are believed to form a substantial part of its food (NATURE, 93, 166; 1914). These larvæ, after their three-years journey from the western side of the Atlantic Ocean, reach British waters about the month of June, and afterwards pass round the northern coast of Scotland until they reach the eastern coasts in November and December, ready to ascend the rivers in spring. Prof. Thompson points out that there appears to be a close and even precise correspondence between this periodic annual migration of the leptocephali and the appearance of the sun-fish in British home waters. Food, therefore, would seem to be a prime governing factor in the movements of these summer invaders, and the fact that the food is drifting in the oceanic plankton gives a false impression of drift also to the appearances of the sun-fish.

Showers of Frogs and Fishes

In "The Story of San Michele" Dr. Axel Munthe makes Turi, the Lapp, tell of toads that "came from the clouds, when the clouds were low the toads fell down in hundreds on the snow. You could not explain it otherwise for you would find them on the most desolate snow-fields where there was no trace of any living thing" (p. 127). Perhaps Turi was recounting fact, perhaps he was but repeating a tradition derived from that chapter of the "Historia" of Olaus Magnus of Uppsala which in 1555 was written "Concerning the Rain of Fishes, Frogs, Mice, Worms and Stones".

Yet there are many well-authenticated records of the fall of frogs and fishes from the clouds, and the two most recent occurrences happened in the month of May. On May 15, 1900, on the outskirts of Providence, Rhode Island, a heavy downpour of rain brought with it so many living perch and bullpouts, from two to four and a half inches long, that children gathered them by the pailful and sold them; and on May 18, 1928, a rain of fishes, hundreds of them, fell on a farm in North Carolina, three quarters of a mile from the nearest water-course, which did not contain any number of fishes.

From many sources Dr. E. W. Gudger has collected, and in several papers has published the records of about seventy-one accounts of rains of fishes ranging from 300 A.D. to 1928, and from all parts of the earth. A great number of the stories come from the United States (15), but more from Great Britain (17), from the rest of Europe about 16, from Asia 19, Australia 7, South Africa, South America and the South Seas one each.

The explanation of these showers of frogs and fishes is the same in every case. High winds, particularly whirl-winds, pick up water in the form of water-spouts with such aquatic organisms as the water contains and carry them until the velocity of the air and clouds becomes relatively lowered and the organisms, alive or dead, fall to earth.

Societies and Academies

DUBLIN

Royal Irish Academy, Jan. 23. **JOSEPH ALGAR, ISABELLA M. MCCARTHY** and **EVELINE M. DICK**: The synthesis of diflavones. When diacetoresorcinol is heated with benzoic anhydride and sodium benzoate and the product is isolated without prior hydrolysis, the substance obtained is 3·3′-dibenzoyl-diflavone I (colourless needles, m.p. 292° C.). Hydrolysis of I with alcoholic potash gives yellow needles of 4·6 dibenzoylaceto-resorcinol II (m.p. 203°–204° C.) and II is converted into diflavone III (m.p. 281° C.) by heating with alcoholic hydrochloric acid. Condensation of diacetoresorcinol with anisic anhydride and sodium anisate appears to give the anisate of 7-hydroxy-6-anisoylaceto-3-anisoyl-4′-methoxy-flavone IV (pale yellow needles, m.p. 233°–235° C.). The hydrolysis of IV gives 4·6 dianisoylaceto-resorcinol V (yellow needles, m.p. 203°–204° C.) and V on heating with alcoholic hydrochloric acid gives 4′·4″-dimethoxy-diflavone VI (colourless needles, m.p. 321°–322° C.). III exhibits a brilliant blue, and VI a green, fluorescence in sulphuric acid solution.

PARIS

Academy of Sciences, March 20 (*C.R.*, 196, 821–880). The president announced the death of Jules Andrade, *Correspondant* for the Section of Mechanics. **L. CAYEUX**: The constitution of the Devonian phosphates of Tennessee (United States). The remains of echinoderms are of more importance in the Devonian phosphate rocks of Tennessee than in other sedimentary phosphates, and it is their degree of frequency which gives the fundamental characteristic of the deposit. The importance of coral in this formation has been overestimated. **GABRIEL BERTRAND** and **YÔNOSUKE OKADA**: The existence of lead in arable soil. The quantities found were of the order of 0·2 gm. of lead per kgm. of dry soil. **PAUL PASCAL** and **MME. RÉCHID**: The preparation of the dimetaphosphates. Full details of the method of preparation of sodium dimetaphosphate, free from polymers. Its distinctive reactions are given. **M. GIGNOUX** and **L. MORET**: The external structural units of the Alpine chain between the Pelvoux and Durance. **G. PFEIFFER**: The expression of a system of functions containing two parameters. **V. NIEMYTZKI**: Non-linear integral equations. **ARNAUD DENJOY**: The integration of total differentials and the metric of curves. **V. A. KOSTITZIN**: The asymptotic solutions of the differential equations of the theory of the growth of organisms. **F. E. MYARD**: A general theory of all joints transmitting rotations. **M. MENDES**: A particular case of the problem of n bodies with variable masses. **M. PICARD** and **A. STAMPA**: A new form of silver voltameter. A special form of glass cup is used to prevent particles of silver from the anode reaching the cathode. Recent determinations of the E.M.F. of the cadmium cells at the Bureau of Standards give 1·01827 international volts: using the modified silver voltameter described the author deduces the value 1·01830. **J. VERHAEGHE**: The Faraday effect of a camphor derivative. A repetition of Pfleiderer's experiments on the correlation between the magnetic and natural rotatory dispersions of diphenylmethylenecamphor. The strong anomaly found by Pfleiderer in the neighbourhood of the absorption band was not found. G. Ribaud : A solution of the problem of heterochrome photometry of incandescent lamps. A method of measuring in international candles the light-intensity of tungsten lamps without the mediation of a black body or of a filter, by a simple spectrophotometric measurement on a single wave-length. Privault : Study of the *M* level of magnetised iron. M. Valadares : The spectrography, by crystal diffraction, of the γ- and X-rays of the thorium family. N. Marinesco and J. J. Trillat : The action of ultra-sounds on photographic plates. Plates and papers sensitised with silver salts are acted upon by ultra-sounds (frequencies 428,000 and 1,435,000 cycles per second). This action is probably due to the ultra-sounds *facilitating* the *oxido-reduction* process occurring in the sensitised layer. Mme. Réchid : The plurality of the metaphosphoric acids. H. Bierry, B. Gouzon and Mlle. C. Magnan : The application of the iodometric method to the estimation of sugar in the blood. Bougault's method is applicable to the estimation of the free sugar in the plasma of blood from the horse. The results suggest that the copper-reducing power is due to an aldehydic sugar only. P. Carré and D. Libermann : The reaction of phosphorus pentachloride on the neutral aryl sulphites. The aryl sulphites react with phosphorus pentachloride giving thionyl chloride, aryl chloride and aryl phosphate : the reaction between alkyl sulphites and phosphorus pentachloride described in an earlier paper is different. Jean Décombe : The condensation of the phenols with dimethylamine and formaldehyde. Yang Kieh : The age of the two principal series of granites of the north-west of the French Central Plateau. A. Marin and P. Fallot : The constitution of the whole of the limestone chain of the Spanish Rif from Ceuta to Punta Pescadores. G. Grenet : An apparatus for determining the magnetic properties of rocks. An improvement of Chevallier's method leading to increased sensitivity. Henry Hubert : The comparison, from the point of view of the climatic characters, of the meteorological stations of the French tropical domain. Mlle. M. Friant : The regression of the upper lip in the course of individual ontogeny in the elephant. Charles Taguet : The treatment of tumours and pain by cobra poison.

Sydney

Royal Society of New South Wales, Dec. 7. C. A. Sussmilch : The association of the Tertiary alkaline rocks of New South Wales with late Tertiary tectonic lines. The akaline rocks of New South Wales lie mainly on two belts, an eastern belt and a western belt. In all cases they are situated right on the margin of, or close to, tectonic scarps produced during the Koscuisko uplift of late Tertiary age. The extinct volcanoes of the Canobolas, Dubbo, Warrunbumble and Nandewar district all lie on the western margin of the main tableland of New South Wales where it breaks away rather suddenly by faulting towards the low lying western plains. The alkaline laccolites of the Rylstone area lie along the line of east-west faulting which marks the northern margin of the Blue Mountain Tableland. The alkaline laccolites and lava cones of the Mittagong district lie on an east-west tectonic line (a monoclinal fold) which forms the southern margin of the Sydney *senkungsfeld*. The alkaline rocks of the Taree district occur along a line of monoclinal folding and faulting which forms the eastern margin of the Comboyne Tableland. The same conditions exist in south-eastern Queensland. All of these volcanic occurrences are older than the faulting but it would appear that the outbursts took place along lines of tension which had already developed before the Koscuisko Epoch of uplift actually took place. This would suggest that the volcanic outbursts, although older, are very little older than the Koscuisko uplift, which would make them of late Tertiary age. W. R. Browne : A possible correlation of certain pre-Cambrian granites of Australia and some deductions therefrom. Two periods of plutonic intrusion accompanying orogenic movement may be recognised in the pre-Cambrian of Australia. Those of the first epoch (closing *Archæozoic*) were *essentially gneissic* but without distinctive mineral characteristics : the second series (Middle Proterozoic) was of far greater extent and volume, and from their mineralogical peculiarities and associated ore-deposits it is inferred that much of Australia was in Proterozoic time a petrographical and metallogenetic region. The present distribution of these granites is taken to imply the former existence of a very wide extent of Lower Proterozoic strata in Australia, now mostly removed by erosion. A. E. Bradfield, A. R. Penfold and J. L. Simonsen : The essential oil from the wood of *Eremophila Mitchelli*. The tree is commonly known as 'buddah' and is one of the strongest scented woods of the western districts of New South Wales and Queensland. The wood yields from 2–3 per cent of a viscous dark red oil of pleasant odour and containing three crystalline substances of ketonic character. Warnford Moppett : An examination of the validity of conclusions drawn from experiments in which the allantoic membrane of the chick is exposed to X-radiation. Prepared eggs were exposed to mixed radiation generated by various potentials (90–150 kv.) and selective effects were observed. Equal incident doses were measured with a thermal radiometer. New energy estimate for homogeneous radiation is given and an investigation of dehydration infection, etc., on controls is discussed. J. C. Earl and N. F. Hall : The chemical changes involved in the formation of aminoazo-compounds. (2). Aniline nitrite. Aniline nitrite is present in methanol solutions of equimolecular proportions of aniline hydrochloride and sodium nitrite. Under the influence of acids and heat, chemical changes occur which are made evident by irregularities in the volume–temperature curves of the reaction mixture. Under carefully controlled conditions, *aniline nitrite* can be isolated in a crystalline state ; it dissolves in water, methanol or ether, and in aqueous solution readily undergoes change into diazoaminobenzene. Methanol solutions of the crystalline material with acids show the typically irregular volume–temperature curves. M. B. Welch : (1) Experiments on the daily shrinkage and swelling of wood. A series of measurements was made thrice daily over an extended period to determine the daily lateral shrinkage and swelling of six different woods exposed to varying conditions. Short sections 1 in. in length and 4 in. wide were used to obtain the maximum size variation. In inside and outside positions the maximum size variation in any one day in tallowwood, *E. microcorys*, was only 0·002 in. and 0·007 in. respectively and in Baltic *Picea excelsa*, 0·013 in. and 0·043 in., the other woods falling between these extremes. The sizes and moisture contents are correlated. (2) The longitudinal variation of timber during seasoning. Longitudinal measurements were made at regular intervals during the air seasoning of a number of woods from a green to an air dry condition. The shrinkage ranged from 0·00 to 0·26 per cent. Actually a slight swelling was found to take place in some timbers; other woods showed both shrinkage and swelling. O. U. VONWILLER: Diffraction gratings used with grazing incidence. A discussion on the use of very wide slits in a diffraction grating spectrometer when the angle of incidence is nearly 90° and the angle of diffraction small. Photographs are given of spectra of various orders from sodium flames, weak and intense, using a slit of width 1·1 mm. and collimator focal length 23 cm., illustrating expressions for the intensity, sharpness and resolving power. The effect of dispensing with a collimator is shown and discussed. A simple method, based on this effect, for making the focusing adjustment of a spectrometer, is described. WINIFRED R. MANKIN: Application of optical spectroscopy to analysis of tumor tissue. A method is described of determining qualitatively the presence of metals in a specimen of dried tumor tissue. Besides the metals iron, magnesium, sodium, potassium and calcium which are commonly known to occur in such tissue, there is evidence of the presence of aluminium, chromium, copper, lithium and strontium, manganese and zinc. Quantitative aspects of the problem are being undertaken.

Forthcoming Events

Monday, May 8

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 2.—C. F. White: "Port Work" (succeeding lecture on May 10).

ROYAL GEOGRAPHICAL SOCIETY, at 5.—A. M. Champion: "Soil Erosion in Africa"; G. W. Hobley: "Soil Erosion: A Problem in Human Geography".

UNIVERSITY OF LONDON ANIMAL WELFARE SOCIETY, at 5.30—(at the Institute of Education, Southampton Row, W.C.1).—Dr. R. T. Beatty (Admiralty Research Laboratory, Teddington): "The Sense of Hearing in Animals".

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY, at 6—(at the London School of Economics, Houghton Street, W.C.2).—S. E. W. Taylor: "Morale in Office Work and the Will to Work".

Tuesday, May 9

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. B. Mirkine-Guetzévitch: "The New Tendencies of Modern Constitutions" (succeeding lectures on May 10 and 11).

ILLUMINATING ENGINEERING SOCIETY, at 7—(in the Hall of the Institution of Mechanical Engineers, Storey's Gate, S.W.1).—Annual General Meeting. Discussion on "Principles of Directive Street Lighting".

INSTITUTION OF CIVIL ENGINEERS, at 6.—Annual General Meeting.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Dr. L. S. B. Leakey: "New Evidence of the Antiquity of the Kenya Forms of Aurignacian and Mousterian Cultures".

Wednesday, May 10

GEOLOGICAL SOCIETY, at 5.30.—Sir Douglas Mawson: "The Geology and Glaciation of some Islands of the Southern Ocean and the newly discovered Antarctic Mainland."

INSTITUTE OF METALS, at 8—(Annual May Lecture at the Institution of Mechanical Engineers, Storey's Gate, S.W.1).—Albert M. Portevin: "Quenching and Tempering Phenomena in Alloys".

ROYAL SOCIETY OF ARTS, at 8.—Albert Abbott: "Education for Industry on the Continent and in this Country".

Thursday, May 11

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual General Meeting.

Friday, May 12

CHEMICAL SOCIETY, at 4-6 and 8-10—(at the Chemistry Department, University of Leeds).—Discussion on "Substitution in Aromatic Systems". Papers by Prof. R. Robinson, Prof. C. K. Ingold, Prof. G. M. Bennett, Prof. H. M. Dawson, and others.

ROYAL SOCIETY OF ARTS, at 4.30—(Sir George Birdwood Memorial Lecture).—Sir Walter Morley Fletcher: "India and Medical Progress".

ROYAL ASTRONOMICAL SOCIETY—(George Darwin Lecture).—Dr. V. M. Slipher: "Spectrographic Studies of the Planets".

ROYAL INSTITUTION, at 9.—Prof. W. T. Gordon: "Gem Stones".

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Royal Society of Edinburgh, Session 1932-1933. Vol. 53, Part 1, No. 7: On the Measurement of Spatial Distance in a Curved Space-Time. By Dr. H. S. Ruse. Pp. 79-88. 1*s*. Vol. 53, Part 2, No. 8: A Case of Non-disjunction in the Fowl. By Prof. F. A. E. Crew. Pp. 89-100+5 plates. 2*s*. 3*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The Journal of the Royal Technical College, Glasgow. Vol. 3, Part 1, January. Pp. iv+199. (Glasgow.) 10*s*. 6*d*.

Proceedings of the Royal Society. Series A, Vol. 140, No. A840, April 1. Pp. 240. (London: Harrison and Sons, Ltd.) 12*s*.

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 62, July to December 1932. Pp. 193-396+20+plates 15-33. (London: Francis Edwards, Ltd.) 15*s*. net.

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 4, No. 2, September 1932. Compiled by Agnes Elisabeth Glennie. Pp. iv+182. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

OTHER COUNTRIES

Field Museum of Natural History. Anthropological Series, Vol. 22: The Tanala, a Hill Tribe of Madagascar. By Prof. Ralph Linton. (Marshall Field Expedition to Madagascar, 1926.) (Publication 317.) Pp. 334. (Chicago.) 2.25 dollars.

Department of Marine, Canada. Monthly Record of Meteorological Observations in the Dominion of Canada, and in Bermuda and Newfoundland. October 1930. Pp. 53. November 1930. Pp. 53. December 1930. Pp. 53. (Ottawa: F. A. Acland.) 1 dollar per annum.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 5, No. 3, Mars. Pp. 93-138. (Prague: Regia Societas Scientiarum Bohemica.)

The House of the People: an Account of Mexico's New Schools of Action. By Katherine M. Cook. Pp. vi+73+3 plates. (Washington, D.C.: Government Printing Office.) 10 cents.

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 27, 1931, No. 1. Pp. 181+10 plates. (Calcutta.) 8.4 rupees.

Transactions of the Mining and Geological Institute of India. Vol. 27, Part 4, March. Pp. 261-322+x+plates 6-8. 4 rupees. List of Members, 1932-33. Pp. 27. (Calcutta.)

The Quarterly Journal of the Geological, Mining and Metallurgical Society of India. Edited by K. K. Sen Gupta. Vol. 4, No. 3, December 1932. Pp. 69-118+plates 3-8. (Calcutta: Presidency College.) 6 rupees.

Journal of the Indian Institute of Science. Vol. 15A, Part 9: i. Studies in Enzyme Action, Part 5: Ageing of Amylases in Aqueous Solution, by K. Venkata Giri and V. Subrahmanyan; ii. Studies in Enzyme Action, Part 6: Heat Inactivation of Pancreatic Amylase, by K. Venkata Giri; iii. Studies in the Proteins of Indian Foodstuffs, Part 4: The Proteins of Fenugreek (*Trigonella Fœnum Græcum*), by Y. V. Sreenivasa Rau and M. Sreenivasaya. Pp. 107-124. 1.8 rupees. Vol. 15A, Part 10: Studies in Bridge Formation, Part 1: Attempts to Synthesise Bicyclic Terpene Derivatives by a New Method, by P. P. Patel and P. C. Guha; Part 2: Formation and Stability of a Bridged *Cyclo*hexenone, 1-Dimethylethane-^{1,3,3}III^{1,4,4}-*cyclo*butane-2-one, by P. S. Mayuranathan and P. C. Guha. Pp. 125-137. 1 rupee. (Bangalore.)

Ministry of Finance, Egypt: Survey of Egypt. Paper No. 42: An Ancient Subterranean Aqueduct West of Matruh. By G. F. Walpole. Pp. 40+10 plates. (Giza: Survey of Egypt.)

Association for the Preservation of Game in the U.P. Annual Report 1931-1932. Pp. 35. (Shahganj, Agra.)

The Rhodesian Museum, Bulawayo. Thirty-first Annual Report, 1932. Pp. 14. (Bulawayo.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 83: Weitere Untersuchungen zum vergleich der Fangfähigkeit verschiedener Modelle von vertikal Fischenden Plankton-Netzen. By Cl. Künne. Pp. 36. 2.00 kr. Vol. 84: Rapport Atlantique 1931 (Travaux du Comité de Plateau Continental Atlantique) (Atlantic Slope Committee). Pp. 108. 4.00 kr. Bulletin hydrographique. Appendice du Volume pour l'année 1931: Expedition Internationale du Cattegat du 10 au 17 août 1931. Pp. 63. 3.50 kr. (Copenhague: Andr. Fred. Høst et fils.)

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State-Aided Research in Great Britain*

THE report of the Department of Scientific and Industrial Research for the period 1931–32 contains more encouraging reading than might at one time have been expected in view of the drive for national economy exemplified in the report of the May Committee and elsewhere. The absence of spectacular results in the year under review assists in the task of appraising the work of the Department in relation to national needs and more particularly in regard to new industrial development. There can be little room for doubt that the Department has discharged its difficult task with conspicuous success and that in applying available funds to work of the most immediate practical value to industry, there has been no sacrifice in the interests of supposed economy of the essential efficiency of industrial research organisations, built up over a long period of steady and patient endeavour with the assistance of public funds. True to its firm conviction that unless industry persistently applies scientific method and scientific knowledge to its problems it cannot escape from the difficulties with which it is surrounded, the Advisory Council has at least succeeded in preserving so far as possible the organisation for the pursuit of more fundamental inquiries upon which the future of all industrial research work must depend.

Leaving on one side for the moment this question of fundamental research, the Department's own report indicates how well deserved has been the praise which has recently been lavished upon it by spokesmen of finance as well as the authoritative tributes to its organisation paid last year by the Committee of New Industrial Development of the Economic Advisory Council and by Sir Harold Hartley in his address to the Institute of Transport. These tributes are, however, to be welcomed not merely as indication of appreciation of work already done, but more especially as betokening that spirit of general co-operation upon which the work of the Department is essentially founded.

Upon this question of co-operation the Report of the Advisory Council lays considerable stress. In relation to fuel research, for example, after explaining the importance of provision for an adequate programme of laboratory work and pointing out that extensive laboratory work is the best way of developing that real understanding of root problems which may lead not merely to minor improvements in existing processes but also to suggestions for radical changes in production or in methods of utilising a raw material, the Report continues: "We were also impressed with the extent to which the research stations of the Department are bound to depend for their success upon the co-operation of industrial organisations. The most effective criterion of the value of industrial research is the extent to which its results are put into practice, but the application of the results is difficult to secure unless industry is prepared to take a real interest in the research work in progress."

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* Department of Scientific and Industrial Research. Report for the Year 1931–32. (Cmd. 4254.) Pp. iv+193. (London: H.M. Stationery Office, 1933.) 3s. net.

No feature of the Report is more encouraging than the evidence that is afforded of such co-operation on the part of industry, of a growing realisation that the organisations of the Department are public concerns intended to promote the national welfare and the development of the industries with which they are associated. Certain of the research associations have, for example, succeeded in widening the basis of their membership by the inclusion of industrial groups which are interested either as manufacturers or users in materials discovered or improved by scientific research. Refractories research is an example in point of research which should not be left entirely to the makers of refractories to finance; and there are indeed already signs that the gas, electrical, iron and steel, coke-oven and pottery industries are more disposed to recognise such responsibility and co-operate in support of this work.

The British Non-Ferrous Metals Research Association has been conspicuously successful in this way, and the commercial possibilities of the new ternary lead alloys discovered by the Association have directly resulted in the enrolment of a large number of members from the lead manufacturing industry. Both the address of Sir Harold Hartley and the report of the Committee on New Industrial Development referred to above afford evidence of the approach of the railway companies towards research in these fields, while on the other hand the Cotton Research Association provides an example of conspicuous success attending an active liaison policy. Demonstration of the practical value of its results by sending members of its liaison staff out to mills and works in a series of more than two thousand visits in 1930–31 has given definite evidence of steadily increasing interest and appreciation of the value of scientific research through the industry as a whole.

This attempt to broaden the basis of a research association is, however, only a particular aspect of industrial research to which the Report directs special attention. While the need for research on the production of commodities is as strong as ever, even stronger is the need for research into their utilisation. In almost every industry to-day strenuous effort is directed to the application of old materials to new uses and to the discovery of uses for new materials, and such effort figures prominently in the programme of most of the research associations. Whether it is a case of finding new markets for existing products, of creating a wide demand for a commodity and thus reaping the advantages of modern methods of production, or of discovering the most suitable material for a particular purpose, it is equally important that the chemical and physical properties of the materials concerned should be fully understood.

The stress thus laid on the need of finding new uses and new markets for the products of industry not only encourages, as already indicated, the growth of a spirit of co-operation throughout industry, and particularly between user and consumer, making for better service as well as for more efficient production, but also contributes to that continued industrial development upon which the success of British industry depends. Without such continuous development under the guidance of applied science there can be little hope of survival, much less of recovery for our industrial enterprises in this era of international trade. Of the assistance given by the Department to such new industrial development the Report provides several instances, and it does not appear that the Department has failed, either in its functions of co-ordinating and acting as a clearing house of information from research associations and other organisations, or in the encouragement of the large-scale tests which form the final stage in development research.

Such limitations as have been imposed on the work of the Department in this respect are in the main financial. There has, for example, been a serious reduction in the income which the National Physical Laboratory derives from payments for tests and investigations and from contributions by industry to researches for its particular benefit. This is an unavoidable consequence of industrial depression.

These difficulties, however, are by no means the most disquieting feature of the report. In spite of signal services rendered to their respective industries, certain of the research associations have found themselves in acute financial difficulties and the termination of the activities of the Cutlery Research Association has been followed by the suspension of the activities of the Research Association of the British Rubber Manufacturers. The Department's report comments on the lamentable lack of interest displayed by the cutlery industry in its Research Association as evidenced, for example, by a decline in membership from fifty to ten firms in a couple of years. Similarly, in spite of the highly important and industrially valuable results it has obtained, the British Cast Iron Research Association has had great difficulty in maintaining its industrial income, and in keeping its work going on an adequate scale; to make the Association self-supporting a substantial grant has been made by the Department for the period July 1, 1931–June, 1933.

The position of the Research Association of the British Rubber Manufacturers is related to another aspect of this question upon which the Report also touches. The Association ceased to operate on March 1 for lack of funds. A measure authorising a levy for its support and maintenance on firms in the rubber industry had been introduced into the House of Commons, but as a private member's bill, and it failed to come before the House in time. The Government has, however, now introduced a Rubber Industry Bill in the House of Lords (see NATURE, May 6, p. 650), so that we may hope shortly to see the Association at work again. There would be something farcical in a situation in which, after the State had contributed some £35,000 to the financing of research in an industry, an effort of the industry to place its research activities on an adequate self-supporting basis should have been limited to the introduction of a private member's Bill at the mercy of the slightest opposition from an active individualist minority.

When commenting, however, on the effect of recent political, financial and economic developments, the Advisory Council expresses the earnest hope that "the protection which has now been afforded to certain industries in the home market will be regarded as an opportunity for effecting the changes in organisation, the installation of modern plant, the development of research work and the employment of educated staffs which the experience of the last few years has shown to be necessary in some industries if they are to compete on level terms with industries in other parts of the world."

This is a point of view which might well have been much more forcibly expressed. A good deal of stress has been laid, in arguing the case for tariff protection of particular industries, on the opportunity which such protection affords for research and development and reorganisation on scientific lines. It has indeed been asserted that such temporary protection should be conditional on the industry undertaking to prosecute research and development on a scale adequate to accumulate a sufficient reserve of fundamental knowledge to assist both in tiding over bad times and in meeting independently competition from abroad. Unfortunately, already some industries show signs of a false sense of ease and security leading to relaxation of much needed effort of this kind, and the comment of the Advisory Council is welcome.

It should scarcely be necessary to add that, under tariff conditions more than ever, the technical efficiency of an industry ceases to be a purely domestic matter for the industry itself. When the community has voluntarily surrendered its right to purchase without interference, the protected industry must in return take a much less individualistic view of its obligations to the community. Under such conditions the community should not be expected to be satisfied with less than the highest possible standard of scientific and technical efficiency within the industry. The Government, once it adopted a tariff policy, should have allocated a portion of the revenue thus obtained for the more intensive and extensive prosecution of research in every branch of industry; its omission to do so is a sign that it does not realise the vital importance of industrial research as a factor in national recovery. Without detracting in the least from the ability with which the Department of Industrial and Scientific Research has carried out its varied tasks or the magnitude of the results already achieved, it is still possible to feel that its representations to the Government in certain fields have not been so effective as could have been desired. It is to be hoped that the success and expansion of the various stations now maintained directly under the control of the Department will not be allowed to weaken its interest and support of a scheme of research associations which, as the Committee on New Industrial Development has pointed out, has no counterpart in any other country and represents an attempt to build up an organisation of industrial research adapted to British needs and British psychology.

An Indian Sage

Life and Experiences of a Bengali Chemist. By Prafulla Chandra Rây. Pp. viii+557+6 plates. (Calcutta: Chuckervertty, Chatterjee and Co., Ltd.; London: Kegan Paul and Co., Ltd., 1932.) 7*s.* 6*d.*

A MORE remarkable career than that of P. C. Rây could not well be chronicled. The story told is not only fascinating: it has an altogether special value, as a presentation of a complex mentality, unique in character, range of ability and experience. The caption,

> "nothing extenuate
> Nor set down ought in malice,"
> Othello.

set against the preface, is an indication of the spirit in which the book is written. In part, the study of a life overfull of action, of unusually varied occupations and interests; in no small degree, it is also a dispassionate statement and discussion of pressing, Indian, social problems; as a whole, therefore, it has exceptional value, scientific and social.

(Sir) Prafulla Chandra Rây was born on August 2, 1861. His father (born 1826), a landed proprietor, he tells us, began his career "like a country gentleman in the days of Fielding and had many traits in common with Squire Allworthy". That a Hindu should draw such comparison is remarkable, if only as proof of familiarity with a class of English literature not within even our ordinary range: the book teems with similar, often remote, literary references, showing how fully the author is possessed by the English spirit. This is accounted for by the fact that his father, who was a man of considerable culture, not only proficient in Persian—then the Court language in India—with a smattering of Arabic, also possessed a fair knowledge of classical English literature, acquired at Krishnagar College, under the principal, Capt. Richardson, a pioneer educationist in Bengal and author of "Lives of the British Poets"—a book Rây speaks of as "a priceless heirloom which he has read over and over again". A now surprising item of information he learnt from his father, when almost a child, he tells us, should be here mentioned, "that beef-eating was quite in vogue in ancient India and that the very word for 'guest' in Sanskrit is 'Goghna' (one in whose honour the fat cow is killed)".

Up to nine years of age, Rây was educated at his father's village school; in 1870, the family removed to Calcutta. We learn incidentally that, at that time, water-works had just been completed, so that the town enjoyed the blessing of a liberal supply of properly filtered, drinking water, which, however, the orthodox Hindu long refused to make use of "as being impure".

In 1874, Rây suddenly fell a victim to severe dysentery. Previously of robust constitution and healthy, the disease left him a permanent valetudinarian, a victim of sleeplessness and obliged always to subject himself to a strict dietary regimen and discipline. This makes the great activity he has displayed, throughout his life, all the more remarkable. During the two years he was away from school, he indulged in an orgy of reading. It is more than interesting to note how the Indian duck took to the water of an English classic literature. With such example before us—and India furnishes not a few—we might well try the experiment if it be possible to train English youth by close study of our English literature, leaving all classical study to a post-graduate period—*pace* the former headmaster of Westminster School: 'Oh, English—it's their own language!' Struck by the similarity between Sanskrit and Latin, he made a study of the latter, without the help of a teacher, gaining a passable knowledge of this language and of French. Sanskrit he learnt as a matter of course. Later, in carrying on his final studies in arts, he also attended lectures on chemistry and on physics at the Presidency College. He came under my student friend the late Sir Alexander Pedler and was greatly attracted by his manipulative skill: almost unconsciously he began to acquire a predilection for chemistry. Besides sitting for the B.A., he prepared privately for the Gilchrist scholarship examination and was ultimately one of the two Indian winners.

Rây left for England in August 1882 and entered the University of Edinburgh in the following October. His subjects of study were chemistry, physics, botany and zoology. In chemistry, he came under Crum Brown, of whom he speaks as "now growing indolent and fat" but he adds, "He revelled in speculation and every student of organic chemistry must be grateful to him for the graphic formulæ which he introduced, which considerably helped the progress of our science." However, he learnt to esteem him and the atmosphere was such that he became passionately fond of chemistry. He had Hugh Marshall, Alexander

Smith and James Walker as fellow students; J. Gibson and L. Dobbin were the assistants.

Rây's studies for the B.Sc. were interrupted, for a time, when an announcement was made that a prize would be given for the best essay on "India before and after the Mutiny". He read hard and very widely for this and discovered that he had the faculty of writing with some facility. Although not successful, his essay and another's were bracketted *Proxime accesserunt*; in it, 'he indulged in many bitter diatribes against British rule'—the child was already father to the man. The interruption was only temporary; the essay written, he gave himself up heart and soul to chemistry and gained his doctorate in the inorganic branch. As Hope prize fellow, he took part in the laboratory teaching and claims to have given Hugh Marshall a cobalt salt, which he had prepared, for analysis, which led Marshall to his well-known important discovery of persulphates. He tells of having asked the advice of Prof. Dittmar, a former assistant of Crum Brown, whether he should follow the example set by James Walker in taking up physical chemistry. The reply was—"Be a chemical chemist first!" Many more than know it have cause to rue the fact that such advice has not been theirs and followed. The argument applies equally to the more modern craze biochemistry.

Rây has much to say of the Scottish student's life. Living was cheap. A substantial penny breakfast was by no means uncommon: oatmeal porridge and milk. He recalls Carlyle's account, showing how boys in his day were sent to the University at fourteen and left to fend for themselves—living on the simplest fare from their farm homes and protected by poverty from vicious amusements. Some of us think that it may be well to restore such conditions—if education is to be of value as a preparation for life—if we are to recover our social balance.

At the end of six years, Rây returned to Calcutta, in the summer of 1888. After a year, he secured a professorial post at the Presidency College, Calcutta, becoming a junior colleague to Prof. Pedler, whom he ultimately succeeded. It is a noteworthy fact, showing the innate practical bent of his nature—on which he dilates—that, as soon as he had spare time, he began to work on butter and mustard oil, the two sources of fat in the dietary of the masses in Bengal; this occupied him during nearly three years.

He also engaged in social service. Troubled by the poverty of Bengali literature, on the scientific side, he wrote a primer on zoology, recognising that nature study offers more attractions to the juvenile mind than chemistry. His practical instincts then led him to add to his professorial activities that of a chemical manufacturer and ultimately to establish the Bengal Chemical and Pharmaceutical Works, Ltd. The firm at present employs 2,000 hands. It was a substantial organisation when I visited him in 1914.

A new laboratory for the Presidency College was begun in 1892 and first occupied in July 1894. In 1896, Rây became famous through his discovery of mercurous nitrite, a compound of unexpected stability. The study of the nitrites became his life work in the laboratory and was pursued by him so persistently that the myopic in our Chemical Society almost came to regard him as a public nuisance. He quotes, in this connexion, remarks I made when visiting the Presidency College in the autumn of 1914—"The way in which you have gradually made yourself 'master of nitrites' is very interesting and the fact that you have established, that, as a class, they are far from being the unstable bodies chemists had supposed, is an important addition to our knowledge." As an example of thoroughness his work on the subject stands apart.

He took care from the beginning, however, unlike most European workers, to divide his time equally between the study and the laboratory. After years of severe literary labour, he produced his well-known "History of Hindu Chemistry"—a work which has won universal praise, especially from Berthelot. As he rightly remarks: "English chemists as a class are rather indifferent to the history of chemistry and since the days of Thomson scarcely a single authoritative work on the subject has been written in English by any one of them. They have, in fact, contented themselves with simply translating Ladenburg's or Meyer's treatise dealing with the subject." The University of Durham stands out in having given Rây an honorary D.Sc., in 1912; in conferring the degree, the Vice-Chancellor spoke of his fame chiefly resting upon his monumental history of Hindu chemistry.

In 1916, he retired from the Presidency College to join the newly founded University College of Science. He had done a great work there.

From 1921 onwards, he has been much drawn into educational and political movements, in which he has been a leader. He has also played a leading part in organising relief works against famine and floods. Half the book is devoted to discussion of these activities. The account is worthy of the closest study by those who are interested not only in the future of India but also in the larger problem of education, in general, in relation to the practical needs of the taught.

Our recognition of Râу's services, as chemist, as teacher, as historian and as founder of a great national school of scientific inquiry, is long overdue —it is nothing short of a reproach to our Royal Society that it should hitherto have been so narrow in its outlook as not to include his name in the roll of fellowship.

Often severely critical, Sir P. C. Râу is undoubtedly anti-English in his present sympathies —but he is mainly so on account of his greater sympathy with his fellow Indians—and his criticisms are constructive. He has much to say of faults in the drainage system and is a strong advocate, with Gandhi, of the return of the spinning wheel, in place of the textile factory, in order to provide work for idle hands to do during the long period of unemployment between crops—a problem which we should consider. He deprecates the insane craze for university education—a disease to which we also are subject—finding great fault with the system. His views are summarised in the statement—Western civilisation is our ruin; we are on the way dimly to foresee that it may be ours. Nothing can compensate for lack of proper occupation and substitution of the machine for the man.

From beginning to end, the message of the book is one of the highest endeavour, pulsating with vitality and intellectual force. Few pages are without proof that the author is steeped in our best traditions, no mere nationalist. Full of hope for the future, he ends by saying:

"There is no reason why the Bengali, or for the matter of that, the Indian, should lag behind and not fulfil his destiny. I almost hear the echoes of the organ voice of the author of *Areopagitica*, '*Methinks I see in my mind a noble and puissant nation, rousing herself like a strong man after sleep and shaking her invincible locks.*' "

A man who begins with Othello and can thus end with Milton must be one with ourselves: ultimately, such a spirit cannot be at variance with ours and our joint task should be to strive to work together in fullest harmony of purpose—as complementary parts of one nation.

HENRY E. ARMSTRONG.

A Symposium on Science

Science in the Changing World. By Thomas Holland, H. Levy, Julian Huxley, John R. Baker, Bertrand Russell, Aldous Huxley, Hugh I'A. Fausset, Hilaire Belloc, J. B. S. Haldane, Oliver Lodge. Edited by Mary Adams. Pp. 286. (London: George Allen and Unwin, Ltd., 1933.) 6*s*. net.

IT cannot be said—if we listen-in to the programmes broadcast by the British Broadcasting Corporation—that the British public is ill-provided with views as to the leading questions which exercise the public mind. The volume referred to above, a collection of talks, is an admirable example of a great subject, fairly treated by competent speakers on all its main sides. They have all the character of clear and interesting exposition; they are well arranged and answer one another so far as is possible in this form of discussion; they are summed up and reconciled by the greatest master in this art, Sir Oliver Lodge. The gist of the volume is, of course, the enormous importance of science in the contemporary world and its possibilities for the future good of society, if we know how to make use of it rightly. Only two, what may be called negative, voices are admitted, Mr. Hugh Fausset's and Mr. Hilaire Belloc's. They say some wise words which are in substance complementary to the main theme, and are duly appreciated as such in Sir Oliver's concluding chapter.

Those who look for information and definite fresh views will find most of them in the two sections contributed by Prof. H. Levy and Dr. J. R. Baker. They were allowed the larger space and made excellent use of it. Prof. Levy, giving again the point of view developed in his "Universe of Science", with some lively detailed illustrations drawn from an aeronautics research laboratory, describes the general scope of science and the procedure of the scientific investigator. He has six chapters. Dr. Baker, in four, gives a masterly and delightful account of man's biological position, comparing him with the other primates, and summing up the main stages, which in the present century have re-created for us on an unassailable scientific basis the early human type which stood just above the apes. This particular section will probably be found the most useful in the book for those who desire a clear statement of a profoundly interesting advance in scientific thought, unencumbered by the multitude of facts, names and classifications which generally accompany it.

There is one section of the book which is calculated to set people thinking on lines which reach rather further than the rest, indeed raise the deepest questions which may be suggested by the title. This is Prof. Julian Huxley's paper on "Man and Reality". He takes up the now well-known point connected with the name of Sir James Jeans—rather an *obiter dictum* when it was first uttered—that mathematical analysis seems to lead us to the idea of a mind of mathematical quality as the creating force in the universe. Prof. Julian Huxley, speaking as a biologist, replies that to him mind is an integral part of the universe, that something of the nature of mind must inhere in the essence of things. In this case the general conclusion would be that "the pressure of circumstances", what other thinkers have called the action of the "life-force", has driven mind to become more and more important and elaborate, until finally in man it has become self-conscious and the most important single characteristic of the most important embodiment of the life-force. This is Prof. Huxley's thesis, slightly paraphrased. We stress it here in contrast with the creative mathematical idea as the most profound and general topic which arises from the subjects treated in this symposium.

Those concerned with philosophical thought and teaching at the universities may well reflect on the need of coming more closely to grips with questions which go to the root of our view of the universe and man's position and prospect in it. The eager response which greets the occasional utterances of thinkers like Jeans and Eddington when they let themselves go, indicates clearly the public demand for guidance. It cannot be said that so far English philosophers as a whole have realised the need, or striven seriously to qualify themselves to meet it. F. S. MARVIN.

Reflexology

General Principles of Human Reflexology: an Introduction to the Objective Study of Personality. By Prof. Vladimir Michailovitch Bechterev. Translated by Emma and William Murphy from the Russian of the 4th (1928) edition. Pp. 467. (London: Jarrolds Publishers (London), Ltd., 1933.) 21*s*. net.

BRITISH and American workers in psychology owe a debt of gratitude to the translators and publishers of this book for making accessible to them the life-work of the late Prof. Bechterev. Although somewhat overshadowed by the greater international reputation of Prof. Pavlov, Bechterev is an important and influential figure. He taught the essentials of behaviourist doctrine before the American school of behaviourists was born, and yet avoided some of the more indefensible exaggerations of J. B. Watson and his followers.

The essence of Bechterev's method is the abandonment of all reference to conscious processes, and the investigation only of reflexes and behaviour. Such non-subjective study has, in fact, added much to our knowledge of human psychology, not only as used by Bechterev and the behaviourists but also in the hands of other psychologists, since none but eccentrics resemble the 'subjectivist' of Bechterev's criticism in interesting themselves only in states of consciousness.

Every method of attack is justifiable in psychology if it leads to fruitful results in increased knowledge of human behaviour and thought. Every method becomes dangerous when its advocates begin to claim that it is the sole scientific method in psychology. Bechterev was convinced not merely that he was founding a new science but also that this was the only science of human personality and behaviour. The value and interest of many of the experiments of Bechterev and his followers must not blind us to the extravagance of this claim. Bechterev's work is indeed not free from the defects of prescientific psychology —such as anecdotalism and speculation. The fourth chapter, on energy, is a bad example of unscientific vagueness. He is content to define energy as "movement", he says that the "thing-in-itself" is merely "potential energy", and speaks of the energy of a nervous current as being "transformed into the molecular energy of the muscles".

The making scientific of our knowledge of human behaviour and thought is not to be accomplished by narrowing the field of study to reflexes and other externally observable data, and leaving the field of conscious data to uncontrolled speculation, but by the application to the widest possible range of psychological data of the proved methods of science—exact observation and experiment, measurement wherever this is possible and the sceptical testing of numerical results by statistical methods. To this desirable end, Bechterev's reflexology seems to have made a lesser contribution than might have been hoped.

R. H. T.

Short Reviews

Annual Reports on the Progress of Chemistry for 1932. Vol. 29. Pp. 344. (London: Chemical Society, 1933.) 10*s.* 6*d.* net.

THE appearance at the end of each February of the "Annual Reports on the Progress of Chemistry", issued by the Chemical Society, is naturally an event of some importance in the chemical world. The value of this publication is not, however, restricted to chemists, but is apparent to those who are interested in almost any of the natural sciences. This year the report on general and physical chemistry is the joint work of Mr. E. J. Bowen, Mr. C. N. Hinshelwood, Dr. N. V. Sidgwick, Dr. H. W. Thompson, and Mr. J. H. Wolfenden, each of whom has written one or more of the nine sections: general; the 'true' degree of dissociation of strong electrolytes; the thermochemistry of electrolytes; quantum mechanics and electrochemistry; chemical kinetics; photochemistry; flames and the mechanism of chemical change; the structure of simple molecules from spectroscopic, X-ray, and electron diffraction data; and general stereochemistry. Prof. H. Bassett again reports on inorganic chemistry, Dr. J. J. Fox and Mr. B. A. Ellis on analytical chemistry, Mr. A. G. Pollard and Mr. J. Pryde on biochemistry. The reports on organic chemistry are on this occasion contributed by Dr. E. H. Farmer (aliphatic), Dr. G. A. R. Kon (homocyclic) and Dr. H. King (heterocyclic). The report on geochemistry by Mr. A. F. Hallimond covers 1931 and 1932, whilst that on radioactivity and sub-atomic phenomena, by Dr. A. S. Russell, is also a two-year report.

So much of fundamental importance and of general scientific interest is discussed that a short review can give but little idea of the subjects examined. As he turns over the pages and sees references to the hydrogen isotope of mass 2, to an announcement that krypton combines with chlorine and bromine, to the reaction $\mathrm{Li}^7+\mathrm{H}^1=2\mathrm{He}^4$, to the discovery of the neutron, to evidence for the existence of elements 85 and 87, and to equally solid, although less spectacular, advances in organic and biological chemistry, it becomes evident to the 'ordinary man of science' who desires to keep abreast of progress in the chemical branch that this is just such a series of appreciations as he needs. A. A. E.

Physikalisch-chemisches Taschenbuch. Herausgegeben von C. Drucker und E. Proskauer. Band 1. Pp. viii+546. 29 gold marks. Band 2. Pp. viii+481. 17 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932–1933.)

THE two volumes of the "Physico-Chemical Pocket-Book" are actually small enough to be carried (one at a time) in the pocket; but they include more than 1,000 pages of well-illustrated text and will cost the English buyer more than £3. The text is divided into nine sections as follows: structure of matter, optics, electricity, magnetism, micromechanics (molecular physics), macromechanics, chemical statics and dynamics, heat, systematics of inorganic and organic chemistry. The various sections have been divided amongst a team of some forty-eight writers, several of whom are well-known authorities on the subjects which they handle.

It is difficult to assess the value of such a publication, apart from experience of using it over a considerable period of time. In particular, it does not contain the tables of data that one expects to find in a chemists' pocket-book (for example, no values of Sugden's atomic and molecular parachors are included in the text); it consists rather of a series of brief reviews of our present knowledge of various branches of physical chemistry, and of the methods of measurement which are now in use, with the relevant equations for applying them. A teacher who knows the book well might therefore find it useful to refer his students to particular sections; and a student who has not time to master one of the longer treatises on physical chemistry might find it useful to survey the field with the help of this 'small-scale map'; but in general the book may very well be added to one's collection, in order to compete with neighbouring volumes of abstracts, annual reports, monographs, textbooks and treatises as a means of information and as a pointer to the original sources.

The Proper Study of Mankind. By B. A. Howard. Pp. 254. (London: Ginn and Co., Ltd., 1933.) 3*s.* 6*d.* net.

THE headmaster of the Addey and Stanhope School has written an excellent short book on a fascinating topic. Perhaps too it is the most important which faces those who have to train young people for their work in life. How are we to accommodate our teaching of history, morals and religion to the new views of man's early history and evolution?

One must believe that the change will be in the long run strengthening and stimulating, as Mr. Howard makes sufficiently clear in his book; but the transition, the way of pouring in the new wine, calls for very careful thought, and it has not yet come into the range of current and popular discussion. Hence the very interesting, open-minded and high-thinking treatment of the subject in Mr. Howard's volume is specially welcome. Darwinism is assumed as the starting point and its implications fully explored. The stress is rightly laid on the necessity of treating the life-process as one continuous thing of which man is the highest known manifestation, and the fact that man's mind is the supreme factor in the analysis of the evolution occupies the largest part of the author's small space. How our thinking may be made more effective and reliable is the subject of the concluding sections, and a syllabus, sketching the whole and suggesting points for discussion with a class, is appended.

It is an extremely careful and useful piece of work. If one general critical impression may be added, it is that the tone leans rather more than is necessary towards a gloomy view of the present world-situation and its dangers. F. S. M.

The Flint Miners of Blackpatch. By J. H. Pull. Pp. 152 + 8 plates. (London: Williams and Norgate, Ltd., 1932.) 10*s.* 6*d.* net.

BLACKPATCH, a prehistoric mining site on the Sussex Downs, was discovered by Mr. Pull ten years ago, and since then, with the assistance of Mr. C. E. Sainsbury, he has devoted himself to its excavation. It lies in the middle of a stretch of downland, extending from the Adur to the Arun, which teems with evidence of prehistoric man, including Cissbury and Chanctonbury Rings. Seven mine shafts, twelve burial mounds, four chipping-floors and several pit-dwellings have been excavated; but much more remains to be done before the history of the site can be completely elucidated. It is evident that the site was mined under the influence of the round barrow people, though it is a matter of doubt whether some of the shafts may not have been mined in pre-round barrow times. The exact date of the mines has not yet been determined, though it is probable that they were being worked as late as the end of the round barrow period. The skeletal remains of two individuals, one male, one female, were discovered. These have been examined by Sir Arthur Keith and exhibit evidence of a first cross between round and long barrow peoples.

Mr. Pull's excavations have evidently been conducted with great skill and his results are described with full and constant reference to their bearing on broader issues. He has made a valuable contribution to the history of the flint-mining industry in Britain.

Middlesex in British, Roman and Saxon Times. By Sir Montagu Sharpe. Second edition, revised. Pp. xix + 240 + 5 plates. (London: Methuen and Co., Ltd., 1932.) 15*s.* net.

SIR MONTAGU SHARPE has made considerable additions to this new edition of his account of the archæology of Middlesex in the period extending from just before the Roman conquest down to Domesday, which was first published in 1919. It will be scarcely necessary to recall his vivid reconstruction of Middlesex life in the British period, the detailed treatment of matters affecting the land and settlement, or the intimate knowledge of county topography which was displayed in the discussion of communications, of the exact point at which Cæsar crossed the Thames, or of the scene of Boadicea's last battle.

The attention which was directed in the earlier edition to the Roman land survey and its relation to the ancient ways, has borne fruit and much fresh information is now incorporated. A much enlarged and revised chapter argues that the Roman land system with the decuria survived in Saxon times in the common field and the tything and is to be discerned in detail in the particulars of Domesday. Other additions or revisions are a new table giving with dates the earliest known form of the names of many places in the county, a diagram explaining the Roman method of distributing plots for cultivation in the common fields, and a map of the common fields in a Middlesex parish so late as 1813.

Modern Handbooks on Religion. By the Rev. A. C. Bouquet. (1) *A Study of the Ordinary Arguments for the Existence and Nature of God.* Pp. iii + 63. 2*s.* 6*d.* net. (2) *Religious Experience: its Nature, Types and Validity.* Pp. v + 133. 3*s.* net. (3) *Phases of the Christian Church: a Short View of its History.* Pp. v + 150. 4*s.* net. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1932.)

Too many vital problems are raised in these small handbooks on religion to dispose of them with a few casual remarks. The general aim of the author, however, deserves a strong support. He wishes to restate in the light of modern knowledge, the ordinary arguments for the existence and nature of God, the nature and types of religious experience and the interpretation of the development of Christianism. To Anglicans and non-Conformists in general, these books should be welcome, in so far as the rational and technical study of these questions has been allowed in recent years to fall into the background, partly on account of the emphasis which has come to be laid upon intuition and direct experience, partly because philosophical criticism has apparently weakened its validity and value. To Catholics, however, though some pronouncements and interpretations of the author will appear highly controversial, these studies will provide an alternative ground of reflection, the more so as they are put forward by a sincere Christian and a genuine scholar. T. G.

Drehung der Polarisationsebene des Lichtes. Von W. Kuhn und K. Freudenberg. (Hand- und Jahrbuch der chemischen Physik, herausgegeben von A. Eucken und K. L. Wolf, Band 8, Abschnitt 3.) Pp. ii + 142. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932.) 12.80 gold marks.

THIS monograph is in four sections dealing with the asymmetric molecule, optical rotation and circular dichroism, physical explanations of optical rotatory power and optical rotation in relation to chemical constitution. It contains an excellent account of the work done by the authors in Heidelberg and Karlsruhe, and will be welcomed by those who wish to read it in a less costly medium than Freudenberg's "Stereochemie".

The Royal Entomological Society of London

On May 3, 1833, a few enthusiastic entomologists met in the rooms at the British Museum then occupied by Mr. J. G. Children, at that time an official of the Natural History Department, and resolved to establish a society for the promotion of the science of entomology in its various branches. This was the inauguration of the body which, under the designation of the Entomological Society of London, has just completed a hundred years of useful and increasingly beneficial activity.

Previous attempts had been made to form an association with the same or similar objects, the first of which attempts can be traced to a date at least so early as 1745, when an association, under the name of the Aurelian Society, is recorded to have held meetings at the Swan Tavern, Change Alley. This, however, and several other societies afterwards established with the like aims, had only an ephemeral existence; and it was reserved for the small company which met as stated on May 3, 1833, to found an organisation which, after passing through many vicissitudes and suffering many perils that seemed to threaten its very existence, has to-day reached a position of permanent security.

To this result many distinguished votaries of the science have, in their several ways, contributed. Among the original members of the Society was J. O. Westwood, to whom more than to any other person is due, as the present honorary secretary, Dr. S. A. Neave, says in the "History of the Entomological Society" which he has compiled with the assistance of the registrar, Mr. F. J. Griffin, and just published*, the successful growth of the enterprise during this early period. Westwood was unremitting in his efforts for its welfare; the influence which he exercised in various official positions, including three periods as president, was most valuable; and in the jubilee year, 1883, his services met with due recognition by his unanimous election as honorary life president.

Those who knew Westwood recall with affectionate appreciation his genial and kindly nature, tempered with a touch of oddity, and his old-fashioned outlook on many scientific questions, not entirely unprejudiced, but never bitter. His association with Hope, one of the original officers, led to his appointment as keeper of the collection and library presented by Hope to the University of Oxford, and ultimately to his occupancy of the Hope professorship of zoology founded in 1861.

The financial difficulties encountered by the Society in a critical period of its career might well have been fatal to its continued existence but for the generosity of J. W. Dunning, a fellow of Trinity College, Cambridge, whose gifts, many of them anonymous at the time but now known to be his, included the whole expense incurred in connexion with the grant of the Royal Charter in 1885 and cannot have fallen far short of £1,000.

In the list of those who have occupied the presidential chair are found the names of Sir John Lubbock, afterwards Lord Avebury, Lord Walsingham, F. Du C. Godman, R. Meldola, R. Trimen, N. C. Rothschild and Lord Rothschild. H. W. Bates was president in 1868–69, and was followed in 1870 by Alfred Russel Wallace, his associate in their famous journey to the Amazon. Bates again became president in 1878. Darwin was an original member, and was vice-president in 1838, but never filled the presidential chair.

Besides Westwood, the only other recipient of the honour of the life presidentship until the present occasion was the Rev. W. Kirby, joint author with W. Spence of the well-known "Introduction to Entomology". At the recent centenary celebration, Prof. E. B. Poulton, who succeeded Westwood as Hope professor at Oxford, was accorded the highest honour in the power of the Society to bestow, and became the third holder of the distinguished office of honorary life president. Prof. Poulton, who had held the presidentship on three separate occasions, was acknowledged by all to have advanced the cause of entomology in general and of the Society in particular more efficiently than any other living person. The introduction which he has furnished to the admirable "History" of the Society is a most interesting record of his memories of the Society over a period of fifty years, and includes some notable words both of warning and encouragement, the fruit of wide experience and ripe consideration. It was universally felt that he was, without any doubt, the right person to preside over the Society in this hundredth year of its existence, and his holding of the office is happily signalised by the Royal Command in accordance with which the Society has now the distinction of adding the word 'Royal' to its name.

It is interesting to note the various places in which, from time to time, the Society has found a home. The first general meeting after the founding of the Society in J. G. Children's quarters at the British Museum took place at the Thatched House Tavern, St. James's Street; but before the end of the year a fresh domicile was acquired at 17 Old Bond Street. Here the Society remained until 1852, when it removed to 12 Bedford Row. Some years after this, an arrangement was made by which the library was left at Bedford Row, but the meetings were held by the hospitality of the Linnean Society in the latter's rooms at Burlington House. In 1874 a proposal was set on foot for an amalgamation of the two Societies; but difficulties arose about the accommodation of the library, and the scheme fell through. In 1875 a home was found for the entomologists at 11 Chandos Street, quarters which they occupied as tenants of the Medical Society of London, until in 1920 the present house, 41 Queen's Gate, was bought and in the course of the next few years was gradually adapted for all the purposes of the Society.

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* The History of the Entomological Society of London, 1833–1933. By Dr. S. A. Neave, assisted by F. J. Griffin. With an Introduction by Dr. E. B. Poulton, and a Financial Chapter by A. F. Hemming. Pp. xlvi+224+8 plates. (London: Entomological Society of London, 1933.) 10s. 6d.

That this solution of the housing difficulty became possible was due to the exertions and generosity of many of the Society's members, and especially to the untiring activity and skilful management of W. G. Sheldon as honorary treasurer. The house in its present condition must strike every visitor as being excellently fitted for its purpose. The library, which occupies the whole of the first floor, contains the extremely valuable collection of books belonging to the Society, well arranged in substantially constructed bookcases and adequately catalogued. There are a council room and commodious offices on the ground floor, but the chief glory of the house is the new lecture room, which has been built on the basement level at the back of the property. This is a remarkably handsome structure, well-proportioned and suitably furnished; but what gives it its main distinction is the oak-panelled interior and finely moulded ceiling, the latter a reproduction of the work in the Bromley Room at the Victoria and Albert Museum. These features, together with the presidential chair and desk, structures worthy of their surroundings, were provided by Mr. R. W. Lloyd, a fellow of the Society, entirely at his own expense.

On the walls of the rooms and staircase at Queen's Gate hangs an interesting collection of portraits of prominent fellows of the Society; and in one of the ground-floor rooms is a large painting by J. Cooke, "The Aurelians", depicting Dr. G. B. Longstaff, a keen and travelled entomologist and generous benefactor to the fund for the purchase of the Queen's Gate House; and his friend Selwyn Image, also an enthusiastic entomologist and sometime Slade professor of fine art in the University of Oxford.

The celebrations of the Society's centenary lately held were attended by a large number of delegates from the British Empire and from foreign countries. The proceedings included a general meeting on May 3, when speeches were made and addresses presented, a scientific conversazione at Queen's Gate, a reception by the trustees of the British Museum, a supper at the Gardens of the Zoological Society of London, excursions to Tring and to Whipsnade, and a reception by His Majesty's Government at Lancaster House. F. A. D.

'Red Coal'

MAN is unceasing in his quest for power—social, political and mechanical. In his search for sources of mechanical power, which, with a charming allegiance to the past, is still associated with the horse when it is measured, man has dug deep mines to bring 'black coal' to the surface and learned how to convert energy into steam and electricity. He has harnessed the waterfall—'white coal'—to the same end, making it swiftly turn a wheel, a turbine, and put areas containing only rivers on an equality with those perched on top of the coalfields. In one favoured district he has dared those forces of the inner earth which manifest themselves as volcanoes, or in their milder form as fumaroles, and tamed their steam to pass through turbines and generate electricity, which may be regarded as produced from 'red coal'.

The story of this achievement, largely that of Prince Ginori Conti and his devoted band of helpers, is a thrilling one: it has in part been told in these columns by him (NATURE, 121, 59, Jan. 14, 1928), and it has been brought up to date in a lecture delivered by him before the Royal Society of Arts on May 3.

Originally the enterprise was a chemical one to exploit the boric acid contained in the *lagoni* discovered by Höfer in 1777, and begun by Larderel in 1818; for fully fifty years, Tuscan boric acid was practically without a competitor in the world's markets. To-day the use of the steam to produce electricity is the important activity, and to-morrow it may well be that the amount of cheap power produced in this way will have a deciding effect on the progress of Italian industry.

Three factors have contributed to the advance: the gradual development under Prince Ginori Conti's leadership of a technique for steam drilling; the fact that the wells maintain a steady head of steam and are not intermittent like the geysers in Yellowstone National Park; and the development of turbines of the free exhaust type.

The rotary or percussion systems of drilling, or both alternatively, are used; for the *soffioni* steam is often found at a depth of 100 ft. and, as the jet increases in volume, drilling becomes more difficult. There comes a moment when the steam gains the upper hand and an explosion takes place with the expulsion of stones and mud and a deafening noise which goes on for weeks and can be heard for several miles. The biggest well, completed in 1931, has an output of 440,800 lb. of steam per hour at a pressure of 3·5 atmospheres with a temperature of 205° C. A second large well completed a year after has an hourly output of 396,000 lb. of steam.

The total output of steam from all the wells of the district is now estimated at more than two million lb. per hour. Only a portion is utilised for feeding the power plants; these are yielding continuously 12,000 kw. for which there is a regular demand. Now that confidence in the trustworthiness of the supply has been obtained, the amount of power generated may be expected to increase rapidly.

The volcanic region around Larderello has been but scantily explored so far; it is believed, however, that all the Tuscan *soffioni* have one common origin.

The choice of condenser or free exhaust turbines is an economic question involving careful study. The latter have advantages from the point of view of economy in installation, upkeep and running costs, but they also have a higher steam consumption.

There is little that is new in the production of boric acid at Larderello, which is putting on the market a crude acid of 95 per cent purity; this industry is to-day a highly competitive one consequent on the discovery of vast quantities of boric acid at Searles Lake, California, and elsewhere.

The steam contains about 6 per cent by weight of gas, of which about 92 per cent is carbon dioxide. A large plant has been erected for its separation and compression, both to liquid and solid carbon dioxide, both products which have increasing importance for refrigeration and other purposes.

Work is in hand also to separate the sulphur dioxide for the production of hyposulphites and sulphites, and further, the methane which, if obtained sufficiently cheaply, can be made the source from which to obtain numerous synthetic carbon derivatives. It is projected even to obtain the rare gases, including helium, which, it is believed, is present in sufficient proportions to justify its separation.

To those with vision, the whole achievement is a very remarkable one. The *soffioni* steam is being exploited in the most complete manner, both on account of its thermal and of its chemical value: to draw from the earth a source of power and at the same time obtain from it an antiseptic, a fertiliser, a refrigerant, a photographic chemical, an illuminating gas as well as the rare gases, makes the inferno a source of wealth far richer than Aladdin's Cave. The exploitation of such riches is a task which is taxing to the full the ingenuity and ability of Italian engineers and chemists, who are proving well fitted for their honourable task. There can be no more convincing example of a saying of Sir Oliver Lodge's which Prince Conti quoted: "There is lavishness in Nature but no waste."

The organisation under the leadership of Prince Conti has been built up as the result of full recognition of the vital importance of what pure or fundamental research can contribute towards the better utilisation of natural resources: it was also emphasised how completely it has enjoyed the support of the Italian National Government. Great have been the ravages wrought in Italy by volcanic disturbances; perhaps they may be to some extent equated in the future by the benefit arising out of the harnessing of their forces in the manner described.

E. F. A.

Leicester Meeting of the British Association

FROM the point of view of the British Association, Leicester is a changed city since the meeting in 1907. When the Association meets there on September 6–13, a whole range of fine buildings will be found to have become available since 1907 for its use. The Wyggeston Girls' School, where the reception room, offices, and one of the sections will be established, must be one of the most notable buildings of its kind in the country. The University College, though it occupies an old building, was not established at the time of the last meeting: it now offers accommodation for sections and the inspiration which, for such an occasion as an Association meeting, is afforded by the mere existence of such an institution. The Wyggeston Boys' School adjoins it. The De Montfort Hall is admirably suited for the inaugural meeting. These and other available buildings have the advantage of being situated conveniently to the centre of the city but outside it, a consideration making for the comfort of audiences as external noise is avoided, and access is easy.

Among the many points of interest for scientific visitors in the area for which Leicester is the centre—and they are far more numerous than is realised, probably, by most people—Loughborough College must be specially mentioned. This institution, the outcome of engineering and kindred activities during the War, is of peculiar interest in itself. But not only this: it also offers, what Leicester itself does not, save for the purposes of the secretariat and a few other members, a remarkably fine series of hostels. Living accommodation in hostels during Association meetings is found always to be popular among visiting members, and those who like it need not be discouraged by the distance of thirteen miles from Leicester, for rail and road communications are easy and quick.

The preliminary programme just issued and obtainable from the Association offices at Burlington House, Piccadilly, London, W.1, gives details of the foregoing arrangements and much else besides. The city itself is seen to be well provided with hotels and private hotels convenient to the meeting-rooms. The list of possible excursions and visits indicates the wide scientific interests of the locality. Charnwood Forest, Derbyshire, the Fen Country, the Warwickshire area, are all within reach. Many industrial, agricultural, and educational establishments are to be seen, the last including University College, Nottingham.

The president, Sir Frederick Gowland Hopkins, combining for the year the onerous duties of the chairs of the Royal Society and of the Association, will deal in his inaugural address with the chemical aspects of life. As for the programme of scientific transactions at large, the Association cannot be accused of neglecting current affairs of public interest. The policy of tackling such topics as the gold standard and increasing the supply of gold, a national educational system, the evolution of terrestrial life, industrial physics, and others which find place in the present programme, has its rewards, and occasionally something more. The introduction of some pregnant subject of public concern has sometimes led people to ask why the Association does not do more than merely talk about them: a few were disappointed last year when one noteworthy pronouncement was not followed by immediate action; and quite lately a newspaper correspondent demanded that the Association should not merely formulate a remedy for unemployment, but also apply it. Such action may be scarcely within the Association's powers.

On the other hand, the effort indicated in the programme and by documents issued along with it, to bring the publications of the Association more widely into notice, is an effort, deserving of all support, toward the removal of a weakness. The Association, though supplying to the ephemeral press and to specialist publications a vast range of scientific material, has never yet itself become as effective a recording instrument as stronger public support might make of it.

The Association, from the point of view of those who must raise local funds for its reception, is a less exacting guest than it used to be, and it is right and indeed necessary that this should be so. The programme gives amply sufficient evidence of the hospitality which Leicester intends to offer, including as it does a reception to be given by the Lord Mayor (Councillor Arthur Hawkes), another by the Leicester Literary and Philosophical Society, and a garden party by the University College. Nor, as already suggested, will Leicester fail in the heavy task of finding meeting-rooms—for in that matter the Association does not moderate its demands. Yet, when sections ask to form departments and run two or three meetings at once, or propose to arrange cinematograph or other demonstrations, it would be ungenerous to deny opportunities to the devoted bands of workers who arrange the sectional programmes for the honour of science and the Association, and maintain, as in the present programme they certainly do maintain, the high standard of interest which they and their predecessors have set up. Participation in the Leicester meeting may be confidently recommended, for the sake not only of the Association, but also of Leicester.

Obituary

PROF. W. C. UNWIN, F.R.S.

TO understand the great debt which engineering science owes to the late Prof. William Cawthorne Unwin, it must be remembered that it was in 1856 that he started on his engineering career and that it is sixty-five years since he first began to teach engineering. Born at Coggeshall in Essex, on December 12, 1838, Unwin had all the advantages of being brought up in academic surroundings, for his father, Dr. William J. Unwin, was principal of Homerton College.

On leaving school in 1856, Unwin was fortunate in being apprenticed to Sir William Fairbairn, an engineer and a most distinguished research worker in engineering science. As might be expected in those early days of experimental engineering, the work was of a most varied nature and this had an important bearing on Unwin's later work. Elaborate researches were carried out on the specific volume of saturated steam, and on the effects of repeated loading of plate girders, the most arduous part of the experimental work devolving on the young and enthusiastic Unwin. But, though interesting and instructive, engineering research was not very remunerative and, no doubt, Unwin was recalling his own experiences when in one of his latest addresses, he deplored the fact that the importance of engineering research was not even then recognised by those who had charge of great engineering undertakings. Working at engineering research all day Unwin found time at night to continue his studies, and in 1860 took the degree of B.Sc. at the University of London, where he played so important a part many years later when the course for a degree in engineering was being arranged.

In 1862, theoretical and practical training completed, Unwin became manager at the works of Messrs. Williams at Kendal where the manufacture of Thomson's new vortex turbine had been begun. Then, in 1867, he was appointed manager of the engine department of the Fairbairn Engineering Company. He remained, however, only a short time with this firm, as in 1868 he was made instructor in marine engineering in the Royal School of Naval Architecture, and in 1872 he was appointed professor of hydraulics and mechanical engineering at the Royal Indian Engineering College, Coopers Hill, which position he held until 1884. In 1877 was published his textbook on the "Elements of Machine Design", probably the most widely known of all his books and deservedly so. He wrote as a teacher who gave his readers the necessary information acquired either by his own research or by that of others. Clear and concise explanation was his strong point, and so no textbooks are required to explain Unwin.

Unwin's great success as the teacher of young engineers became possible when in 1884 he was appointed professor of civil and mechanical engineering in the newly established City and Guilds Central Technical College. London was at last to have a college in which engineering science could be taught systematically, in suitable laboratories, equipped with all the necessary plant and apparatus. Four departments were established—chemistry, engineering, mathematics and physics—presided over by Armstrong, Unwin, Henrici and Ayrton respectively, all experts in their subjects and all experienced and enthusiastic teachers. From its very initiation the College was a success, and as a school of engineering an unparalleled success. Unwin's engineering students, trained in specially arranged courses in mathematics, chemistry, and physics, were able generally to profit fully from the instruction given by their exceptional teacher and though, at first, employers did not realise the importance of having trained engineering assistants, still in time Unwin had the gratification of seeing his former students holding the highest positions in the engineering profession and in industry.

Unwin knew that to teach engineering one must practise it, and owing to his international reputation, he had no lack of consultation work. In 1890 an American company appointed an international commission of five eminent experts under the presidency of Lord Kelvin (then Sir William Thomson) to determine the best way of developing the power at Niagara and distributing it. The headquarters of the Commission were at the 'Central' and Unwin was the secretary. In his report he discussed fourteen different proposals which were presented and none of which was considered suitable. He continued to serve on the Commission, making several trips to Niagara to study the conditions of the problem on the ground and advising in connexion with the actual project. He also carried out a long research on the flow of tidal waters in the Thames with reference specially to the pollution of the upper waters by the sewage from the London main outfalls. He was consulted with regard to the Coolgardie Hydraulic Scheme and prepared a report on the loss of head in the mains of the proposed South Staffordshire power gas scheme.

Recognised now as the leading expert in engineering education, Unwin was practically the author of the course in engineering for the London degree and so naturally the course laid down was the same as that followed at the 'Central'. When later the 'Central' became the engineering section of the Imperial College of Science and Technology, Unwin often stated that one of the chief advantages to the University would be the possibility of having many alternative subjects for the degree—a possibility of which advantage has been taken in later years, certain courses given at different schools of the University being recognised as equivalents, allowing in this way a much wider choice to the student.

In 1904 Unwin resigned his professorship, being appointed professor emeritus, but he by no means gave up his engineering practice. His close touch with the profession was maintained. On the council of the Institution of Civil Engineers he had a large part in framing the new proposals relating to the preliminary training of the civil engineer, and when in 1911 he was elected president of the Institution, his presidential address discussed specially the training of the young engineer. In 1915 he was elected president of the Institution of Mechanical Engineers, and again in 1916.

It is usual in this generation to speak of a man's War service, and certainly mention of Unwin's must not be omitted. At the age of seventy-seven he devoted his technical knowledge and business ability to his country and served on the Management Board of the Metropolitan Munitions Committee from 1915 until 1918.

Unwin was a great teacher. While not a brilliant lecturer he was always sound and was valued by those looking for reliable up-to-date information expressed in the clearest language. That his lectures outside the class-room were highly appreciated may be judged by the number of special lectures he was asked to give: the Cantor lectures, the Howard lectures, the James Forrest and James Watt lectures. In the class-room his lectures were definitely serious. In an engineering college in which there is only a qualifying entrance examination there must be many students who are not likely to go very far in the profession, but all those who attended Unwin's lectures remember him with affection. He was not one to suffer fools gladly, but he was very willing to help the real student. He did not wander in the least from the subject in hand, and he had his own methods for gauging his students' capacity. In later years they were often surprised to know how much the professor knew of the personality of each of his students. He had a keen sense of humour, but he probably appreciated his own jokes more than those of other people.

Unwin's long life, though filled with interest, was uneventful. He did not marry. While a most genial companion, he would not talk of himself, and his correspondence was only professional. His published papers, reports and textbooks range into all fields of engineering so that his working hours were fully occupied. But he did take vacations, though his recreations were tranquil and scientific. He was an enthusiastic fisherman and devoted many hours to photography, having begun as an amateur in the early days of the wet plate, and on all his travels a camera went with him. Though he had travelled considerably he was no wanderer, and it is typical of him that he lived the last fifty years of his life in the same house where, since his retirement from the 'Central', his niece, Miss Dorothy Unwin, was his devoted companion. He died on March 17. Few men who have lived to so great an age have left so many who are glad to have known them.

Naturally many distinctions were conferred on him. He was awarded the Kelvin medal, was a fellow of the Royal Society, LL.D. of Edinburgh, honorary member of both the American Societies of Civil Engineers and Mechanical Engineers and an honorary associate of the Royal Institute of British Architects.

S. M. D.

News and Views

Sir John Marshall, C.I.E.

SIR JOHN H. MARSHALL, it is reported by the Bombay correspondent of the *Times*, has been awarded the triennial gold medal for historical research by the Royal Asiatic Society of Bombay. Sir John Marshall, who was director-general of the Archæological Survey of India from 1902 until 1931, was formerly a scholar of King's College, Cambridge, and was a student of the British School of Archæology at Athens in 1898–99. He was Prendergast student in 1900–1 and Craven student in 1901–2, while in 1927 his old college made him an honorary fellow. Under his directorship, the work of the Archæological Survey of India has been much stimulated, especially in the direction of excavation of prehistoric and early historic sites. It was due to him that the work was undertaken which led to the epoch-making discovery of the prehistoric sites in the Indus Valley at Harappa and Mohenjo-daro, and on his initiative that the co-operation of investigators from outside the service, experienced in the exploration of the sites of Mesopotamia and with knowledge of the cultures of that area, was invited.

Prof. Paul A. Murphy

THE Royal Dublin Society's Boyle medal, awarded to Prof. Paul A. Murphy in recognition of the value of his work in phytopathology, was presented to him at a special scientific meeting of the Society on May 5. The medal, which was instituted in commemoration of Robert Boyle, the illustrious Irish chemist, is awarded to Irish workers in all branches of science, pure and applied, whose work is adjudged to be of outstanding merit and importance. It was first awarded in 1899 to Prof. G. Johnstone Stoney for his work, which included what was probably the first approximate estimate of the electronic charge. Prof. Murphy's name is the eleventh on the list of holders. In presenting the report of the Committee of Science recommending the award of the medal, Prof. H. H. Dixon gave a brief summary of Prof. Murphy's work, which may be said to have commenced with his investigations in conjunction with Dr. G. H. Pethybridge into the life-history and biology of *Phytophthora infestans*, the fungus responsible for potato blight. Prof. Murphy then attacked the problem of the virus diseases and showed that the progressive deterioration which generally occurs in every variety of the potato is attributable to the accumulation of virus in successive crops. His work has also thrown much light on the complex nature of many virus diseases. He has contributed largely to our knowledge of various diseases of other plants, amongst which onion mildew and dry rot in turnips may be especially mentioned. Sir Frederick Moore, in supporting the award, referred especially to the great value of the work on potato blight, and of the important bearing of the investigations into the virus diseases on the seed potato industry. In making the presentation to Prof. Murphy, the Right Hon. Viscount Powerscourt, president of the Society, pointed out how particularly appropriate it was for the presentation to be made at a meeting held during the Society's Agricultural Show, since Prof. Murphy's work, in addition to being of great importance to pure science, is also a very valuable contribution to the advancement of agriculture, thus linking the two great branches of the Society's activities.

International Colonial Conference, 1935

A BRIEF announcement in the latter part of last month that Lord Lugard had been elected president of the Institut Colonial International at the biennial conference held at Lisbon on April 18–20 seems to have attracted very little attention. In an article by Prof. Basil Williams which appears in the *Times* of May 4, it is pointed out that Great Britain, the power most extensively interested in questions relating to colonial administration, has taken a relatively unimportant part in the conferences held by the Institut. These have been supported more especially by France, Holland, Belgium and Portugal. Great Britain, the United States and Italy, however, as well as these powers, are represented in the secretariat of the Institut. As the next conference will be held in London in 1935, under the presidency of Lord Lugard, and among the subjects already marked for special consideration is the question of the detribalisation of natives, it may be hoped that an active part will be taken in the work of the conference by officials and others who are concerned, whether in practice or as a matter of scientific study, with the administration of native affairs. A conference in London should afford an especially favourable opportunity, such as will not recur for some time to come, of pooling the views and experience of an exceptionally large and well-informed membership on the causes and effects of detribalisation, and, should opinion incline to the view that it is inevitable in the long run, of the best means of controlling and guiding it in the interests of the native. It is, perhaps, too much to hope for any approach towards a native policy common to all the powers and based on a thorough scientific study of the native, which would have any prospect of adoption by the countries represented at the conference.

Indian Rhinoceros at the London Zoo

FELLOWS of the Zoological Society, and the public at large, are greatly indebted to the King, who is the patron of the Society, for the young rhinoceros from Nepal which he has just given for permanent exhibition. It was presented to His Majesty by Maharajah Sir Judha Shumshere Jung, Prime Minister and Commander-in-chief of Nepal. Though the Society has two African rhinoceroses, it has only one Indian, which was presented by the Maharajah of Nepal nearly ten years ago; and since this animal is now found only in Nepal, where it is in sore need of protection if it is to escape speedy extermination, the recent gift is a valuable one. It will be interesting to compare the new arrival, which is 1½–2 years old, not only with the fully adult animal, but also with the African species, because of the striking and singular differences displayed by the two species in the matter of what one might almost call the 'armour-plating' formed by the hide. No one has yet been able to find any explanation for the fact that in the Indian species this forms what looks like a series of separate shields, or 'bucklers', studded with relatively small round bosses, while in the African species the hide forms a continuous covering. Again, we seek in vain for any intelligible explanation of the fact that while the African species has two nasal horns, in the Indian and other Asiatic rhinoceroses there is but one horn. There are, of course, other structural differences between these two types, which, some day, may be compared with all the known fossil remains. When this has been done, we may well find clues such as will help us to gain an insight as to the factors and mode of evolution of these singularly interesting ungulates.

The Old Ashmolean, Oxford

THE two hundred and fiftieth anniversary of the opening of the Old Ashmolean, Oxford, falls on May 21, a date duly recorded by Elias Ashmole, donor of its original possessions. In recognition of this occasion, Dr. R. T. Gunther, curator of the Lewis Evans Collection of Scientific Instruments, housed in the Old Ashmolean, has been able to conclude a series of arrangements to mark the event. Here it may be mentioned that the Old Ashmolean building itself was erected between 1679 and 1683, and is attributed, on fairly good grounds, to Christopher Wren. The appropriateness of this historic establishment for the housing of the Lewis Evans collection of ancient scientific instruments was demonstrated in 1925, when this notable gift to Oxford was dedicated by the Earl of Crawford and Balcarres at a special meeting held in the Old Ashmolean, and the collection was declared open. The principal celebration arrangements referred to above comprise a reception by the curator of the Lewis Evans Collection, on Sunday, May 21, whilst on May 22, at 2.30 p.m., in the University Museum, Sir Arthur Smith Woodward will deliver a lecture on "Plot and Lhwyd and the Dawn of Geology". These naturalists were the first keepers of the Old Ashmolean. During the week, exhibitions of Ashmolean interest will be open to the public, including portraits and relics, books, manuscripts, and engravings.

Centenary of the University of Zurich

THE centenary celebrations of the University of Zurich, which extended from April 28 until May 1, attracted a large number of delegates from the universities and learned societies of the world. At the chief ceremony, held in the noble 'Lichthof' of the University on April 29, the addresses of the Rector (Prof. F. Fleiner) and the director of education of Canton Zurich (Dr. O. Wettstein) were followed by congratulatory speeches by selected representatives of the various nations. The delegates from the British Isles were Prof. A. E. Zimmern (Oxford), Prof. G. H. F. Nuttall (Cambridge), Dr. T. Loveday (Bristol), Sir Henry Miers (Royal Society), Prof. J. Read (St. Andrews), Prof. E. Dieth (Aberdeen), Prof. J. H. S. Burleigh (Edinburgh), and Prof. F. E. Hackett (Dublin). At its foundation, the teaching staff of the University comprised twenty-three professors, thirty-three lecturers, and 161 students; at the present day, it has about a hundred professors, ninety lecturers, and some 2,000 matriculated students. In 1908, the University took a great step forward as a result of a referendum in which the people of Canton Zurich voted in favour of the provision of extensive new accommodation: "durch den Willen des Volkes", runs the inscription carved in stone over the western entrance to the magnificent central building which was erected at that time. The city of Zurich was *en fête* during the celebrations, and the popular interest and pride in the cantonal university were pleasingly evident on every hand. "Akademische Lehr- und Lernfreiheit ist an ihr geltend", is a significant sentence occurring in the original statutes of the University, and the adherence of the University, the canton, and the Swiss nation to the cherished ideals of freedom and toleration formed the keynote of most of the speeches at the celebrations.

Huxley and Scientific Education

HUXLEY memorial lectures have been delivered at the Imperial College of Science and Technology, London, annually since 1925 to commemorate the life and work of Thomas Henry Huxley, who was born on May 4, 1825, was professor of biology from 1854, and dean of the Royal College (then Normal School) of Science and Royal School of Mines from 1881 until his death in 1895. The lecture this year was delivered by Prof. H. E. Armstrong, who, as a pupil of Huxley's, and as professor of chemistry at the Central Technical College, and equally concerned with the outlook and methods of education, was able to garnish his tribute with personal reminiscence and with forceful criticism of the scientific world as it appears to him to-day. Huxley's reputation as a master of education rests, he said, mainly upon his writings and public addresses, not upon his work as a teacher. "He was a marvellous exponent—therefore, a bad teacher, as are all who are eloquent"; "a master of fine logic, but encased in hard bones". Prof. Armstrong attended some of Huxley's lectures, but they failed to hold the interest of one who hoped to learn how things had been found out; nevertheless, he ever regretted that he did not attend the Working Men's Lectures, in which Huxley told a consecutive story.

PROF. ARMSTRONG said he knew no book from which more general inspiration is to be derived than from the third volume of Huxley's essays, "Science and Education", though it was published in 1895 and goes back to 1854; yet there is little in the essays bearing on actual teaching. Huxley was insistent on the need for organisation. "In the sense in which he meant it, we remain unorganised to-day, whilst the need is much greater. Many may think that his

'Essays' are now out of date, that we have introduced Science into the schools and got what he asked for. It is not so. In fact, we have only the shadow—not the substance. The teaching, for the most part, is of the kind he abhorred and knew to be useless." "Huxley was undoubtedly a man of very great innate ability, a man who had gained full grasp of the world; he saw very clearly what the needs were, but was no master of method. Cannot men be found to study his great example but go further, especially in developing methods?" Prof. Armstrong said that it is in connexion with medical education that Huxley's instructions have been least regarded. Huxley complained specifically of the unsatisfactory character of the teaching in physiology and asked for a proper scientific foundation at school, followed by a minimum burden during the period of professional training.

Huxley's efforts to secure public recognition of the value of scientific education, said Prof. Armstrong, led to the establishment of the City and Guilds of London Institute for the Advancement of Technical Education and of its two colleges, the Finsbury Technical College (1879) and the Central Technical College (1884). The latter is now known as the City and Guilds (Engineering) College, and forms part of the Imperial College of Science and Technology. In an address on "Science and Culture", Huxley defended the thesis that for the purpose of attaining real culture an exclusively scientific education is at least as effectual as an exclusively literary education—to which Prof. Armstrong replies that he does not believe that either in itself can give us culture or is, in fact, possible exclusively. "The world insists on teaching a good deal, however much the schools may fail to teach." But Huxley made an important recommendation: that provision should be made for teaching sociology. Already in 1887 he foresaw the coming gravity of our industrial position, and wrote a remarkable letter to the *Times*. He called upon the nation to 'organise victory', and Prof. Armstrong echoed his words. A nation of shopkeepers, we have, he says, worshipped technical education; unfortunately, it has not taught us to keep shop: only to make things to be sold but not how to sell them, to the general good, when made. The problem of food looms in full face of a present need; that our food supply must be our first care is as yet realised by few. We can no longer allow uncontrolled use of the soil. We must learn how to use our knowledge. Scientific workers must bestir themselves to educate the public, even as Prof. Armstrong educates while he castigates.

New Medals of the Royal Aeronautical Society

Two new medals have been founded by the Royal Aeronautical Society, to be known as the British Gold Medal for Aeronautics and the British Silver Medal for Aeronautics. These medals have been founded following a request from Lord Amulree, when Secretary of State for Air, that the Royal Aeronautical Society should give some award for outstanding feats in aviation. A permanent Committee has been appointed to consider the awards of the medals, consisting of six members of the Royal Aeronautical Society, and the chairmen of the Royal Aero Club and the Air League of the British Empire. The design of the Gold Medal incorporates a portrait of Sir George Cayley and his first model aeroplane of 1804, and the design of the Silver Medal incorporates the Henson and Stringfellow machines. The medals will be awarded for an achievement leading to advancement in aeronautical science and will be confined, so far as possible, to subjects of the British Empire, but other nationals will not be excluded. The expenses of founding these two medals have been defrayed by the president, Mr. C. R. Fairey. The first awards of the British Silver Medal for Aeronautics have been made for the following achievements which have led to advances in aeronautical science: Capt. C. F. Uwins, for reaching a world record height in a heavier-than-air craft of 43,976 ft. on September 16, 1932; Squadron Leader O. R. Gayford, and Flight-Lieut. G. E. Nicholetts, who flew from Cranwell, England, to Walvis Bay, South Africa, non-stop on February 6–8, 1933, a distance of 5,340 miles.

Excavations in Northern Mesopotamia

Expectation of the importance of the results likely to be obtained by the joint expedition of the British Museum and the British School of Archæology in Iraq to Tell Arpachiyah in northern Mesopotamia under Mr. M. E. L. Mallowan is fully confirmed by the report of the first half season's work which appears in the *Times* of May 5. The expedition left London in January. It will be remembered that this site was selected for excavation as the result of a preliminary reconnaissance from Nineveh in the previous year. Surface finds of painted potsherds then suggested that this site would probably prove of great importance to the little-known earlier prehistory of northern Mesopotamia. The discovery of pottery of the Ur and Tell el-Ubaid type in mud-brick dwellings of a humble character on the top of the mound carries the first settlement well back into the fifth millennium B.C., and proves the site to be among the oldest yet discovered in Mesopotamia. As excavation proceeds, Arpachiyah is shown to be the centre of convergence for peoples transitional between neolithic and chalcolithic times; while connexions are being traced with Anatolia, Syria, southern Mesopotamia and, through Persia, with Baluchistan. It may be noted, in passing, that Arpachiyah supports and extends the evidence obtained by the American School of Oriental Research at Tepe Gawra and Tell Billa that northern Mesopotamia was a place of settlement for peoples from the north and north-east, who were there subjected to strong cultural influences from the south. Among the more noteworthy discoveries now reported at Arpachiyah are a method of fractional burial which is compared with the practice on the prehistoric site of Nál in Baluchistan, the use of a bucranium or ox's head as a motif to an extent which suggests a special cult, female figurines pointing to affinities with the Anatolian mother-goddess, a variety of beads and amulets, and a store of wheat, the earliest probably in Mesopotamia. Excavations are being carried through the lower levels in the hope of reaching virgin soil.

Road Research Station, Harmondsworth

In accordance with a recommendation of the Select Committee on Estimates of the House of Commons in its Second Report for 1932, arrangements have been made for the Road Research Station at Harmondsworth to be transferred from the Ministry of Transport to the Department of Scientific and Industrial Research as from April 1 last. The Committee of the Privy Council for Scientific and Industrial Research has decided to appoint a Road Research Board to advise generally on the conduct of road research undertaken by the Department, and with the concurrence of the Ministry of Transport, has appointed Major F. C. Cook, deputy chief engineer, Roads Department, Ministry of Transport, to be the first chairman of the Board. The following gentlemen have accepted invitations to serve on the Board :—Prof. R. G. H. Clements, Mr. T. Pierson Frank, Mr. W. J. Hadfield, Mr. W. P. Robinson, Prof. C. G. Cullis, Mr. E. V. Evans, Prof. E. H. Lamb, Prof. C. H. Lees, Lieut.-Col. Mervyn O'Gorman, and Dr. T. Franklin Sibly. The immediate direction and control of road research undertaken by the Department of Scientific and Industrial Research will be in the hands of Dr. R. E. Stradling, director of building research under the Department. Road tests throughout Great Britain under normal traffic conditions will continue, as heretofore, to be carried out by the Ministry of Transport in conjunction with the responsible highway authorities. In connexion with these tests, as well as the research work at the laboratory, and the issue of reports thereon, arrangements have been made for the closest collaboration between the Ministry of Transport and the Department of Scientific and Industrial Research.

Science Teaching

In connexion with the notice of Badcock and Holmyard's "Electricity and Magnetism for Beginners" in Nature of March 11, Dr. Dorothy Turner protests against the suggestion that a good qualitative treatment may involve the danger of dulling the pupils' subsequent interest in the subject when the time comes for more complete quantitative treatment, on the ground that for ninety-five per cent of those attending State-aided secondary schools such a time never comes. We referred Dr. Turner's letter to the reviewer who, however, still maintains that the essential danger to which teachers of science will have to give serious consideration is that, in the otherwise laudable desire to extend the ground covered, anything worthy to be called a training in science may be superseded by just talking about science, with the consequence that the subject may become little more than a branch of English, providing good topics for general knowledge essays.

Rockefeller Gift to the Royal Institution

It was announced by the Managers of the Royal Institution at the general monthly meeting of the members, held on May 8, that the capital payment of £20,000 promised by the Rockefeller Foundation nearly three years ago, on condition of obtaining £50,000 from other sources, had now been received. The gift was promised for the endowment of research in the Davy Faraday Research Laboratory of the Royal Institution, and the fulfilment of the Rockefeller promise implies that in the past three years the Managers have been successful in securing research endowment for the Laboratory to a total capital value of upwards of £70,000.

Spurious University Degrees

A Bill to prohibit the unauthorised use and issue of university degrees, a subject which has been taken up by the Association of Scientific Workers, was introduced into the House of Lords by Lord Jessel on May 3 and read a first time. The main part of the Bill, which, if passed, will be known as the University Spurious Degrees (Prohibition of Use and Issue) Act, proposes to make it a penal offence for any person to use letters after his name denoting a university degree unless he actually holds such a degree ; and also it prohibits the conferment of degrees by any person or organisation other than a recognised university. The term "recognised university" is defined at length ; briefly, it may be described as a university or similar institution granting academic degrees as a result of a prescribed course of at least three years' training or definitely recognised as a university by the government of the country where it is situated. The "Lambeth degrees" conferred by the Archbishop of Canterbury are definitely exempted from the provisions of the Act.

Californian Earthquake of March 10

This earthquake has been studied by Messrs. H. O. Wood and C. F. Richter, seismologists of the Pasadena Seismological Laboratory, and a summary of their results appears in the Mail Report of Science Service, Washington, D.C. for April 19. The intensity of the shock was far less than that of the Nevada earthquake of November 20–21, and may have been less than that of the Santa Barbara earthquake of June 29, 1925. The greater loss of life (about 120 persons) and property caused by the recent shock is attributed to the strongly shaken area being more thickly settled. In some places, considerable destruction occurred and this was probably due to the water-soaked alluvial nature of the ground ; but, in all, serious damage was confined to bad or improperly designed construction. The study of the records of seven seismographs in California under the charge of the Pasadena Laboratory shows that the origin of the earthquake was probably in one of a system of faults that runs parallel to the coast in the district between Huntington Beach and Newport Beach. The depth of the focus seems to have been less than usual and was probably about six miles. Nearly continuous movements were recorded for many hours afterwards, but none of the after-shocks was comparable with the main earthquake.

Announcements

THE first conversazione this year of the Royal Society will be held in the rooms of the Society at Burlington House, London, W.1, on May 17, at 8.30 p.m.

PROF. HENRY E. ARMSTRONG will deliver the sixth Hugo Müller lecture before the Chemical Society, in the meeting hall of the Institution of Mechanical Engineers, on May 25, at 5.30. The title of the lecture will be "Chemistry at the Cross Roads".

MR. H. BRADLEY will deliver the nineteenth "Physics in Industry" lecture before the Institute of Physics at the Royal Institution, 21 Albemarle Street, W.1, on May 23 at 5.15 p.m. The title of the lecture will be "Physics in the Boot and Shoe Industry".

THE Halley lecture for 1933 of the University of Oxford will be delivered in the lecture theatre at the University Museum on June 1, at 5 p.m., by Prof. Henry Norris Russell, professor of astronomy and director of the Observatory, Princeton University. The subject will be "The Composition of the Stars".

AT the ordinary meeting of the Royal Society of Edinburgh, held on May 1, the James Scott Prize for 1933 for an essay or lecture on the fundamental concepts of natural philosophy, was presented to Prof. Arnold Sommerfeld, professor of natural philosophy in the University of Munich. Prof. Sommerfeld, whose lecture was entitled "Ways to the Knowledge of Nature", dealt with a recent book of similar title by Prof. Max Planck, and gave his own views on such questions as the mathematical character of the laws of Nature, causality, duality in physics and in human life.

AT the anniversary meeting of the Royal Society of South Africa, held on March 15, the following officers for the year 1933 were elected :—*President :* Dr. A. W. Rogers ; *Hon. Treasurer :* Prof. L. Crawford ; *Hon. General Secretary :* Dr. B. F. J. Schonland.

MR. H. T. PAGDEN, assistant entomologist in the Agricultural Department, Straits Settlements, has been appointed by the Secretary of State for the Colonies to be entomologist in the British Solomon Islands Protectorate.

IN our issue of April 29, p. 612, reference was made to resignations of Jewish professors from university chairs in Germany. During the past few days, the following three distinguished chemists have resigned their posts : Prof. F. Haber, director of the Kaiser Wilhelm Institut für physikalische Chemie und Elektrochemie, Berlin-Dahlem, who was awarded the Rumford medal for 1932 of the Royal Society for his work on physical chemistry, notably in the application of thermodynamics to chemical reactions ; Prof. H. Freundlich, author of works on colloid chemistry, and Prof. M. Polanyi, distinguished for his work on physical chemistry, both of whom were also at the Kaiser Wilhelm Institut.

THE Society for Cultural Relations between the Peoples of the British Commonwealth and the U.S.S.R. is organising tours of medical men and scientific workers to the U.S.S.R., and the first party will leave London for Leningrad on July 1. The return journey will cost £22–£36 inclusive, according to the type of accommodation selected. The party will spend a total of sixteen days in Russia ; three days in Leningrad, five days in Moscow, then either (*a*) Gorky, down the Volga to Stalingrad—Leningrad ; (*b*) Rostov/Don, Kharkov—Leningrad ; or (*c*) Kharkov, Kiev—Leningrad. The latest date for receiving applications for the first party leaving London is June 15. Inquiries should be addressed to the Secretary of the S.C.R., 1 Montague Street, London, W.C.1.

ON May 23, the second part of a two volume work entitled "An Introduction to the Sociology of Islam", by Mr. Reuben Levy, lecturer in Persian at the University of Cambridge, will be published by Messrs. Williams and Norgate, Ltd., for the trustees of Herbert Spencer, in continuance of his "Descriptive Sociology".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A technical assistant to the Adviser in Agricultural Economics at Armstrong College, Newcastle-upon-Tyne—The Registrar (May 16). A full-time lecturer in chemistry at the Wigan and District Mining and Technical College—The Principal (May 19). A junior assistant bacteriologist and demonstrator at the University of Sheffield—The Registrar (May 20). A Sharpey physiological scholar at University College, London—The Secretary (May 27). A principal at St. Katherine's Training College for Women Teachers, Tottenham—The Rev. Canon G. L. Gosling, S.P.C.K. House, Northumberland Avenue, W.C.2 (May 31). A lecturer in mathematics at East London College, Mile End Road, E.1—The Registrar (May 31). A head of the Department of Electrical Engineering and a lecturer in the Department of Mechanical Engineering of the Central Technical College, Birmingham—The Principal (June 3). A lecturer in organic chemistry at the Manchester Municipal College of Technology—The Principal (June 14). A University lecturer and a University demonstrator in physics—The Secretary, Appointments Committee of the Faculty of Physics and Chemistry, Clare College, Cambridge. A mechanical engineer in the Egyptian Irrigation Service in the Sudan—Chief Inspecting Engineer, Egyptian Government, 41, Tothill Street, S.W.1. A full-time assistant in the Engineering Department of the Technical College, West Hartlepool—The Secretary, Education Offices, Park Road, West Hartlepool. A plant engineer for the locomotive, carriage and waggon shops of the South Indian Railway Co.—Messrs. Robert White and Partners, 3, Victoria Street, London, S.W.1.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Boric Acid in Sea Water and its Effect on the Carbon Dioxide Equilibrium

ACCORDING to recent investigations on the boron content of sea water, amongst others, spectrographic analyses by V. M. Goldschmidt and Cl. Peters[1], the boron content is considerably higher than hitherto assumed. In consequence, quantitative analyses for this substance have been undertaken in several laboratories. The following table shows the results of a series of titration analyses of five different water samples of varying salinity, giving the origin of the sample, the boric acid content in milli-equivalents per litre and in grams B_2O_3 per cub. m., as well as the chlorinities in per mille and the ratio boron to chlorine.

Origin	Latitude	Longitude	$Cl^{\circ}/_{\circ\circ}$	Boron content		Ratio $B^{\circ}/_{\circ\circ}/Cl^{\circ}/_{\circ\circ}$
				m. equ./l.	B_2O_3 gm/m.^{3}	
English Channel, Plymouth	—	—	19·33	0·456	15·9	0·000248
North Sea	55°39′ N	4°50′ E	19·20	0·433	15·1	0·000237
Cattegat	57°35′	11°08′	13·32	0·292	10·8	0·000233
Cattegat	56°16′	12°25′	6·89	0·157	5·8	0·000242
North Baltic	59°30′	22°35′	3·41	0·078	2·7	0·000245

Oceanic water thus contains 15 gm. B_2O_3 per cubic metre as against 0·7 as given in oceanographical textbooks. The values for the ratio boron to chlorine agree well with the results (received by private communication) by H. W. Wattenberg, Institut für Meereskunde, Berlin, who found the value $0{\cdot}250 \times 10^{-3}$, and by E. G. Moberg and D. M. Greenberg, Scripps Institution, La Jolla, California, whose values vary between $0{\cdot}235 \times 10^{-3}$ and $0{\cdot}242 \times 10^{-3}$.

As the presence of boric acid may affect the carbon dioxide equilibrium of sea water, recently investigated by a committee of the International Council[2], it was desirable to repeat the determinations of the second dissociation constant of carbonic acid in *boron-free artificial* sea water. The constant determined by the Committee is a working constant, valid in a certain pH range. The new determinations of K'_2 were carried out at 20°, with artificial sea water of varying salinity. The result may be summarised in the following equation relating the negative logarithm of the constant, pK'_2, to the chlorinity of the water:

$$pK'_2 = 10{\cdot}45 - 0{\cdot}682\sqrt[3]{Cl^{\circ}/_{\circ\circ}} + 0{\cdot}020Cl^{\circ}/_{\circ\circ}.$$

For 35 per mille sea water, the value of pK'_2 is 9·00. By means of this constant and determinations of boric acid and total carbon dioxide, it is possible to calculate also the apparent dissociation constant of boric acid in sea water at different salinities. The following relation was found between the negative logarithm of the constant pK'_B and the chlorinity:

$$pK'_B = 9{\cdot}22 - 0{\cdot}123\sqrt[3]{Cl^{\circ}/_{\circ\circ}} - 0{\cdot}0086Cl^{\circ}/_{\circ\circ}.$$

For water of 35 per mille the value of pK'_B is 8·72. Calculation of the different carbonic acid constituents of sea water is possible when chlorinity, pH and alkali reserve are known. The values of total carbon dioxide as given in the tables worked out by the Committee of the International Council are at the most 2·5 per cent lower than those obtained when both pK' and the corrected pK'_2-value enter into the calculations. The tension of carbon dioxide is not appreciably affected by the boric acid.

KURT BUCH.

Thalassological Institute,
Helsingfors, Finland.
March 20.

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[1] Goldschmidt, V. M., und Peters, Cl., "Zur Geochemie des Bors II". *Nach. Gesell. Wiss. Göttingen*, Math.-Phys. Klasse, 1932. III. Chemie, etc. 28. IV. Geologie, etc. 31. S. 536.

[2] Buch, K., Harvey, H. W., Wattenberg, H., und Gripenberg, S.: "Über das Kohlensäuresystem im Meerwasser". Conseil Perm. Inter. pour l'Explor. Mer. Rapports et Procès-Verbaux. Vol. 79, 1932.

Calcium Isotope with Mass 41 and the Radioactive Half-Period of Potassium

CAREFUL determinations have been made of the atomic weight of calcium extracted from two very old potassium-rich deposits—one a felspar from Rhiconich, Sutherlandshire, estimated at 1,000 million years old, the other a pegmatite from Portsoy, Banffshire, probably about 600 million years old. Each mineral contained approximately 9 per cent K_2O and less than 0·3 per cent CaO, so that there seemed reasonable grounds for hope that the accumulation of the calcium isotope with mass 41, through the slow radioactive disintegration of the potassium in the deposit, might be sufficient to induce a detectable change in the atomic weight from the normal value.

Extraction with hydrochloric acid removed about one-third of its calcium content from the finely pulverised rock very rapidly. The residue proved much more resistant and, in view of the probability that 'abnormal' calcium atoms, occupying the position of their parent potassium in the crystal lattice, were being preferentially extracted, no attempt was made to carry the process to completion.

180 gm. of crude calcium oxalate was thus obtained from about two hundredweights of each mineral. This oxalate was rigorously purified in accordance with the procedure of Hönigschmid and Kempter[1], to ensure the removal of all traces of barium and strontium, then converted to the nitrate and repeatedly recrystallised. Finally, the ratio $CaCl_2$: 2Ag was determined, using all the standard refinements of technique.

Six determinations with Rhiconich calcium gave an atomic weight of 40·092, with a probable error of 0·0006. Six determinations with Portsoy calcium gave an atomic weight of 40·089, with a probable error of 0·0004. Parallel experiments with calcium derived from recent marine sources—sea-shells and Bermuda limestone—gave values of 40·076 and 40·077 respectively.

From the above results, the radioactive half-period of the potassium isotope with mass 41 may be calculated on two limiting assumptions: (*a*) that all the calcium with mass 41 existent in the rock was extracted therefrom, and (*b*) that only one-third of this calcium was extracted. The resultant times are, on the former assumption, 2×10^{12} years (Rhiconich) and $1{\cdot}3 \times 10^{12}$ years (Portsoy); on the latter assumption, 7×10^{11} years (Rhiconich) and

$4{\cdot}3 \times 10^{11}$ years (Portsoy). The value indicated is thus of the order 1×10^{12} years, in definite agreement with the recent work of Mühlhoff[2].

JAMES KENDALL.
WILLIAM W. SMITH.
THOMAS TAIT.

Chemistry Department,
University, Edinburgh.
May 2.

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[1] *Z. anorgan. Chem.*, **195**, 1; 1931.
[2] *Ann. Rep. Chem. Soc.*, **27**, 310; 1930.

Surface Tension of Colloidal Solutions, and the Action of Light on Soap Solutions

SOME time ago[1] a discussion arose between Prof. Mahajan and myself about the interpretation of a phenomenon which I described for the first time in 1922, namely, the slow decrease in the surface tension of colloid solutions in general, as a consequence of the adsorption in the surface layer. I showed that this decrease could be followed step by step by means of a proper instrument.

Prof. Mahajan questioned my interpretation of the mechanism of this phenomenon especially in the case of Boys's soap solutions, and suggested that it was due to the action of light, as he had noticed a difference whether the solutions were kept in the dark or not. I replied and, I believe, I succeeded in convincing him that the phenomenon in question was indeed due to adsorption in the surface layer, and of a much greater amplitude than that which might be attributed to the action of light alone.

Since then, I have had an opportunity of checking at the same time my statements and Prof. Mahajan's, and I found that, as I had suggested, the effect of light—which is real—was small in comparison with the main phenomenon, namely adsorption as a function of time. This being settled, credit must be given to Prof. Mahajan for his discovery of this effect. The figures given below will indicate the relative importance of the two factors.

Decrease of Surface Tension of Sodium Oleate solutions as a Function of Time
(Exp. Sept. 30, 1931)

	Solution kept in the dark and measurements made in the dark.	Solution exposed to daylight for 3 hours.
Decrease at concentration of 10^{-4}	3·3 dynes	6·2 dynes
Decrease at concentration of 10^{-5}	18·3 „	23·6 „

Here we observe a difference of 2·9 dynes and 5·3 dynes at two different concentrations, in favour of the solution exposed to light. The difference is not always so important: another experiment, at a concentration of 10^{-4}, gives a difference of 2·2, another one (Oct. 5, 1931) shows no difference at all (1·6 in both cases), and another still, shows a greater drop for the wrong solution. However, in general, there is a difference, and the difference increases when the dilution increases. At a concentration of 10^{-3} the difference may be of the order of 0·1 to 0·5 dyne, while it reached as much as 6·4 dynes, in one experiment, at 10^{-5}.

We must not forget, however, that when dealing with a soap solution at a concentration of 10^{-4}, the *measurable* dynamic surface tension of which is about 43 dynes, we are forced to neglect the first, and almost instantaneous drop from 73·7 dynes (pure water) to 43. When we deal with more dilute solutions (10^{-5}) the dynamic surface tension rises to 73 dynes—very close to that of pure water—and the observed drop amounts to as much as 26 dynes (in the dark).

To summarise, we can say that the drop in the surface tension of colloidal solutions in general, and in particular of soaps, is due as I have contended since 1922, to adsorption as a function of time, as predicted by elementary thermodynamic considerations, and as expressed by the Gibbs-Thomson equation.

To this general statement we can now add that Prof. Mahajan has shown that, in the case of soap solutions, light has an effect, and increases the amplitude of the decrease. The increase may reach the order of magnitude of 20–25 per cent of the total drop, when the solutions are highly diluted (10^{-5}). When the solutions are more concentrated, the phenomenon is less clear and sometimes even absent, and the percentage cannot well be expressed, as the measurement of the real dynamic surface tension is impossible.

P. LECOMTE DU NOÜY.

Institut Pasteur, Paris.

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[1] NATURE, **128**, 674, Oct. 17, 1931, and **129**, 278, Feb. 20, 1932.

Methionine in Wool

THE method of estimating methyl thiol groups devised by Kirpal and Bühn[1], and Pollak and Spitzer[2] (analogous to the Zeisel process for the estimation of methoxy groups) has recently been used by Baernstein[3] for methionine estimations in a study of the sulphur distribution in a number of proteins. In a subsequent paper, Baernstein[4] refers to the work of Rimington[5] and the writer on the cystine content of keratins, in which it was shown that these substances contain enough cystine to account for nearly all this sulphur, and presumably as a consequence, he did not carry out any determinations of methionine on keratin.

King[6], in discussing the sulphur economy of animal fibre production, has pointed out the possible significance of methionine as a thiol body concerned in the auto-oxidation of glutathione, and thus from these two points of view more definite information as to the amount of this acid in wool becomes of some interest.

Some determinations on wool have been carried out by the author as described by Baernstein, with minor modifications, and with the few wools so far examined, the methionine content is of the order of 0·5 per cent on the dry weight on the keratin. Mueller[7] has actually isolated methionine from wool to the extent of about 0·2 per cent.

In considering the effect on the relationship between total sulphur and cystine sulphur in keratin of this quantity (0·5 per cent) of methionine, which corresponds to approximately 3 per cent of the total sulphur[8], it may be regarded as doubtful if such a discrepancy would be revealed by the Folin-Marenzi technique for cystine determination.

Moreover, recent work of Butz and du Vigneaud[9] shows that methionine, though not reactive to the Folin-Marenzi reagent itself, gives on hydrolysis with acids (particularly with sulphuric and to a lesser degree with hydriodic) 'homo-cystine', the next higher homologue of cystine, which is reactive to the Folin-Marenzi reagent.

Thus although it appears that methionine may be present in wool keratin to the extent of 0·5 per cent (and the possibility of other sulphur acids occurring in small amount must not be overlooked) it does not influence unduly the previous conclusion of Rimington[4] and the writer, that substantially the whole of the sulphur in keratin may be accounted for as cystine, even though some methionine, because of its hydrolysis to 'homo-cystine', may have been previously recorded as cystine when using the Folin-Marenzi technique.

The complete distribution of sulphur in keratins will be more readily realised when more precise methods are available for the determination and isolation of cystine.

JOHN BARRITT.
Wool Industries Research Association,
Headingley, Leeds, 6.
April 6.

[1] Kirpal and Buhn, *Monats. Chem.*, **36**, 853; 1915.
[2] Pollak and Spitzer, *ibid.*, **43**, 113; 1922.
[3] Baernstein, *J. Biol. Chem.*, **97**, 663; 1932.
[4] *ibid.*, **97**, 669; 1932.
[5] Barritt and Rimington, *Biochem. J.*, **25**, 1072; 1931.
[6] King, *Trans. Far. Soc.*, **29**, 258; 1933.
[7] Mueller, *J. Biol. Chem.*, **56**, 157; 1923.
[8] Barritt and King, *J. Text. Inst.*, **17**, 394T; 1926.
[9] Butz and du Vigneaud, *J. Biol. Chem.*, **99**, 135; 1932.

Priestley as a Practical Chemist

WITHOUT wishing to be captious, may I say that the statement by Prof. Meldrum at the Chemical Society on April 6 (NATURE, April 15, page 555) that Priestley had confessed himself "not a practical chemist", seems to me to convey rather a wrong impression, because I fancy that by the term *practical chemist*, Priestley meant something a little different from what we nowadays would mean by the expression.

In the passage in which the phrase occurs ("Experiments on Air", 2nd edition. 1776. Vol. II, page 1) Priestley says he "*had no access to any person of that profession*" and on page 51 speaks of having got Dr. Higgins to make him a quantity of red lead. From these, and other passages, I fancy he meant by the term *practical chemist*, a person who made his living by the preparation and selling of chemical compounds—a professional chemist.

Priestley was an amateur, and might very well have claimed to be—though I do not know if he did so—an *experimental chemist*, which is much the meaning of *practical chemist* at the present day, and, in this sense of the term, Priestley was perhaps the most practical chemist that ever lived.

T. S. PATTERSON.
Organic Chemistry Department,
University of Glasgow.
April 14.

Upper Limit in Explosive Chain Reactions

THE existence of an upper limiting pressure for explosion in thermal chain reactions has been explained in two ways. (1) The rate of branching of the chains, at the limit, is just sufficient to balance the rate of gas phase deactivation of the carriers; (2) a sudden change in the nature of the absorbed layer of gas on the walls of the reaction tube leads to the ejection of atoms or molecules into the gas capable of starting the chain. In two recent letters[1] to NATURE, the gas phase deactivation theory has been further extended to explain the occurrence of the upper limit. It may be of interest, therefore, to describe an experiment with phosphine-oxygen mixtures in which it can be shown that in the region above the upper limit there is a gradual decrease in the length of the reaction chains as the pressure is increased.

In order to initiate the chain, dissociation of the phosphine molecule was effected by collision with an optically excited ($2\,^3P_1$) mercury atom[2]. The pressure of the phosphine was maintained at a constant value (0·130 mm. mercury) and a series of experiments was made at different oxygen pressures with the mercury lamp burning at a constant intensity. As can be observed from Fig. 1, the rate of reaction increases at first, reaches a maximum and then decreases; and the pressure of oxygen at the maximum is of the same order as that where the curves representing the upper and the lower limit coincide[3]. The chain length consequently increases in the region below the lower limit, but above the upper limit it apparently decreases as the pressure of gas rises.

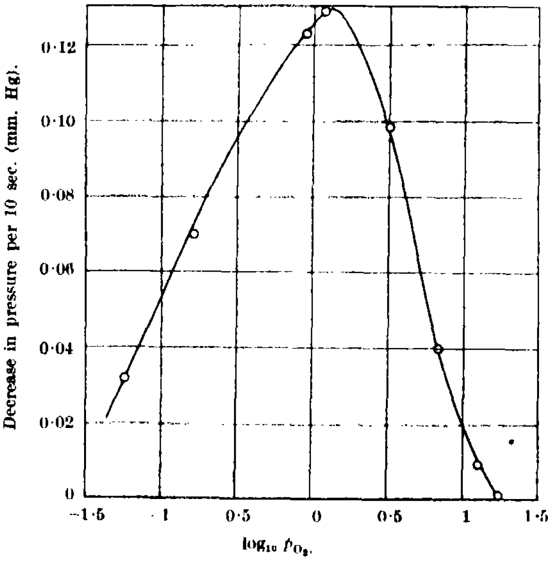

FIG. 1.

It might be argued that this decrease in chain length is due to deactivation of the mercury atoms by oxygen as the oxygen pressure is increased. Taking this factor into account, the rate of oxidation of phosphine is then given by

$$R = -\frac{d[\mathrm{PH}_3]}{dt} = \frac{K_1 k_1 [\mathrm{PH}_3]}{k_1[\mathrm{PH}_3] + k_2[\mathrm{O}_2] + 1/\tau} \cdot K_2[\mathrm{PH}_3] f([\mathrm{O}_2]),$$

the first term representing the rate of starting and the second the chain length; k_1 and k_2 are velocity coefficients and τ the mean life of the excited mercury atom. If $f([\mathrm{O}_2]) = [\mathrm{O}_2]$, as is probably the case below the lower limit, R would increase with $[\mathrm{O}_2]$ and tend to a maximum steady value when $[\mathrm{O}_2] >> [\mathrm{PH}_3]$. The fact that R decreases shows that $f([\mathrm{O}_2])$ is of the form $1/[\mathrm{O}_2]^n$ and hence the chain length must decrease as $[\mathrm{O}_2]$ increases. From the results, it may be readily shown by plotting $1/R$ against $[\mathrm{O}_2]^2$ that n approaches unity. The oxygen molecule is thus an inhibitor for the reaction in this region by virtue of its deactivating influence on the chain carriers in the gas phase. As the upper limit is approached, such deactivation diminishes until the rate of branching effects a balance between the two, and explosion occurs.

H. W. MELVILLE.
H. L. ROXBURGH.

Chemistry Department,
University of Edinburgh.
March 24.

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[1] Ubbelohde, March 4, p. 328; Hinshelwood and Grant, March 11, p. 361.

[2] Melville, *Proc. Roy. Soc.*, A, **138**, 374; 1932.

[3] Dalton, *ibid.*, A, **128**, 263; 1930.

Interaction Between Soot Films and Oil

IF a piece of glass, say a 3 in. × 1 in. microscope slip, is thinly smoked in a luminous flame, allowed to cool and a drop of oil allowed to fall from a height of a few centimetres on to the film, a circular pattern is formed immediately, radiating from the centre of the drop. This figure usually has a central part of concentric striæ of soot, surrounded by a circle of clear dots formed by the withdrawal of soot and its concentration at their peripheries. These dots are surrounded by a further region of rather larger dots with an outer annulus of smaller ones, all formed by the concentration of soot into the surrounding areas. Breaks in the outlines in places show that the figure is strained. Outside the figure, annular regions of attenuation and concentration may be observed. The figure is usually about 0·5 cm. in diameter but varies with the size of the drop. The structure is strong enough for the oil to be washed off the glass with an appropriate solvent, when it may be preserved by mounting *in situ* with Canada balsam-xylene. It may also be formed by letting balsam, instead of oil, fall on the smoked slide.

The following liquids have been found to yield patterns: medicinal paraffin, which is very viscous, castor oil, cotton-seed oil, olive oil, and ordinary paraffin. Peripheral disruption was shown by bromoform, pentachloroethane, chloroform and nitrobenzene. Aniline yielded a pattern with central disruption and radiating effects. Cyclohexanol and cyclohexanone yielded patterns. With glycerol and with sulphuric acid, disruption of the film occurred.

Observation of the film as the drop falls shows that an evolution of gas occurs, the gas bubbles being responsible for surface stresses which drag the film away from the glass under them. Both new films and films formed overnight yield patterns. As oil which has been recently boiled forms patterns, it would appear that the gas is adsorbed by the soot as the film is formed and is not that dissolved in the oil.

I have not seen this effect described; if it had been, it would surely have been well known to microscopists, as the patterns form very beautiful objects under a magnification of from 20 to 50 diameters. They are easily visible to the naked eye and most of the structure can be seen under a hand lens. The general appearance is like a plant section or a coarse circular diatom.

J. H. COSTE.

Teddington.
April 8.

Production of Electronic Oscillations with a Two-Electrode Valve

IN 1920, Barkhausen and Kurz discovered that an ordinary three-electrode valve could be made to give rise to oscillations of very high frequency (greater than 3×10^8 cycles per second) if the grid was maintained at a relatively high positive potential while the anode was made slightly negative with respect to the filament. The explanation for the occurrence of such oscillations appears to be that a condition of negative resistance is possible when the electrons are given a to and fro motion within the valve. It occurred to me some time ago that such a vibratory motion of electrons should be obtainable from a two-electrode valve of special design but circumstances prevented the construction of the valve until recently.

The valve, constructed by H.M. Signal School, Portsmouth, consists of a central metal rod anode of 1 mm. diameter around which are arranged four filaments in parallel spaced equally on a ring 12·5 mm. diameter. When the filaments are heated and the anode is maintained at a high positive potential, the electrons are attracted from the external cathode towards the anode. A certain number of electrons, however, escape capture by the anode and travel towards the filament diametrically opposite to that from which they were emitted. In this way the necessary to and fro motion of the electrons may be obtained in a diode without any external field being necessary as in the case of the magnetron. Preliminary experiments have shown that the valve behaves in exactly the way predicted and strong oscillations have been obtained. Another important feature is that by means of a tuned external circuit the frequency of the oscillations appears to be adjustable within fairly wide limits while all other operating conditions are kept constant.

A two-electrode valve of somewhat similar design has recently been described by J. Sahánek[1], but he gives a different explanation for the occurrence of oscillations.

J. S. MCPETRIE.

National Physical Laboratory,
Teddington.
April 4.

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[1] J. Sahánek, *Phys. Z.*, **33**, 693; 1932.

Structure of the Lines of the Arc Spectrum of Silver

THE fine structure of the more important lines of the arc spectrum of silver was examined by means of a reflecting echelon grating of high resolving power. This instrument and its mounting have been previously described[1]. The light source was a tube of fused silica fitted with external electrodes similar to those used by me in the investigation of the structures of the arc lines of indium[1], thallium[2], and gallium[3], excited by means of a high frequency oscillator. The discharge tube was filled with neon at a pressure of about 0·5 mm. of mercury, and the capillary portion of the tube contained a small quantity of silver chloride. The capillary was heated to a temperature of about 600° C. All the lines examined were found to be simple. The half-value width of the lines was determined by obtaining two images of the line under investigation on the same plate, making two exposures at different pressures of the air surrounding the echelon grating; the separation of the images at the smallest pressure difference at which the two images could still be resolved was measured and taken to be the half-value width of the line.

Now the half-value width of a line with no fine structure (a simple line) due to the Doppler effect arising from the movement of the atoms is equal to $\nu \times \sqrt{\theta/M}/1{\cdot}2 \times 10^6$, where ν is the frequency of the line, M is the atomic weight and θ the absolute temperature of the radiating atoms. In the following table the observed half-value width of the lines examined is compared with the calculated width for a simple line.

Line	3280 $1S_{1/2}$-$2^2P_{3/2}$	3380 $1S_{1/2}$-$2^2P_{1/2}$	5209 $2^2P_{1/2}$-$3^2D_{3/2}$	5465 $2^2P_{3/2}$-$3^2D_{5/2}$	5471 $2^2P_{3/2}$-$3^2D_{3/2}$	4055 $2^2P_{1/2}$-$4^2D_{3/2}$	421 $2^2P_{3/2}$-$4^2D_{5/2}$
Observed half-value width of line	0·07 cm.$^{-1}$	0·07 cm.$^{-1}$	0·04 cm.$^{-1}$	0·04 cm.$^{-1}$	0·04 cm.$^{-1}$	0·05 cm.$^{-1}$	0·05 cm.$^{-1}$
Calculated width of simple line	0·07 cm.$^{-1}$	0·07 cm.$^{-1}$	0·04 cm.$^{-1}$	0·04 cm.$^{-1}$	0·04 cm.$^{-1}$	0·05 cm.$^{-1}$	0·05 cm.$^{-1}$

None of the observed lines has a greater width than that calculated for a simple line. It can therefore be concluded from the observed width of the lines of the diffuse series that any structure in the terms $2^2P_{1/2}$, $2^2P_{3/2}$, $3^2D_{3/2}$ and $3^2D_{5/2}$ must be less than 0·04 cm.$^{-1}$; and from the width of the resonance lines, any structure in the $1S_{1/2}$ term must be less than 0·07 cm.$^{-1}$ (The triplet structure observed by Mohammad and Sharma[4] in the resonance lines is due to self-reversal of the lines given by the vacuum arc lamp they used and also a ghost in the Lummer plate fringes in the ultra-violet.) This simplicity of the $1S_{1/2}$ term is of the greatest interest for it signifies that any doubling of this level arising from magnetic moments of the nuclei of the silver isotopes must be smaller than 0·07 cm.$^{-1}$ This seems to indicate an abnormally low magnetic moment of the silver nuclei; for the $1S_{1/2}$ term of copper has a doublet structure with a separation of about 0·3 cm.$^{-1}$, and since the $1S_{1/2}$ term of silver corresponds to a more penetrating orbit, it would be expected that, if the silver nuclei possessed magnetic moments comparable with those of the copper nuclei, the $1S_{1/2}$ term of silver would possess a doublet separation of the order of 0·5 cm.$^{-1}$

It has been suggested to me by Dr. S. Tolansky that the absence of structure in the deeply penetrating $1S_{1/2}$ level does not prove that the magnetic moments of the silver nuclei are abnormally small. In the spectrum of thallium, the $2S_{1/2}$ and $2^2P_{1/2}$ terms possess large hyperfine structures, while the $2^2P_{3/2}$ term, which corresponds to an almost equally deeply penetrating orbit, possesses no observable structure. No explanation of this anomaly has been found, and it must therefore be considered possible that, owing to a similar cause, a normal magnetic moment of the nuclei gives rise to no observable structure in the $1S_{1/2}$ term of silver. The absence of fine structure could also be explained by ascribing a mechanical moment of 0 to the nuclei of silver; but this seems to be improbable as silver possesses two isotopes of odd atomic weight (107 and 109) and all atoms of odd atomic weight hitherto investigated have been found to possess mechanical moments.

Clarendon Laboratory, D. A. JACKSON.
Oxford.
April 4.

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[1] D. A. Jackson, *Proc. Roy. Soc.*, A, 128, 508; 1930.
[2] D. A. Jackson, *Z. Phys.*, 75, 229; 1932.
[3] D. A. Jackson, *Z. Phys.*, 74, 291; 1932.
[4] W. Mohammad and P. N. Sharma, *Indian J. Phys.*, 6, 75; 1931.

Fine Structure of the Resonance Ag I Lines

THE structure of the silver lines 3280 A. and 3383 A. have been examined with Lummer plates by W. Mohammad and P. N. Sharma[1] using a specially constructed vacuum arc. They report identical triplet structures of intensity ratio 5 : 5 : 1 and separations of 0·218 and 0·116 cm.$^{-1}$ respectively, the weaker component being on the violet side. They therefore attribute this structure to the common $5s^2S_{\frac{1}{2}}$ term, which, with a J value of $\frac{1}{2}$ should only give a fine structure multiplicity $2J + 1$ when $J \ll I$. A triplet could only arise if there were an isotopic displacement effect and provided the g (I) factors of the nucleii differed so that two of the four components superposed. In this somewhat unlikely event the intensity ratios should be very different from the values quoted above since the abundance ratio is unity. This, however, would not be a serious contradiction since it is well known that intensity measurements with resonance lines are necessarily unreliable owing to self-absorption.

We have examined these lines with 25 and 35 plate reflection echelons, employing water and liquid air cooled hollow cathode discharges. Two hollow cathodes of 8 mm. internal diameter and 15 cm. length were used, the one consisting of 5 per cent silver and 95 per cent cadmium, the other with the proportions reversed.

With both cathodes, the two lines appeared single, of a total width not exceeding 0·050 cm.$^{-1}$, when the discharge current was low (0·1 amp.). As the current was increased these particular lines broadened while the other lines remained equally sharp. With the silver cathode a sharp reversal occurs at about 0·2 amp., the width of the clear centre band steadily increasing with heavier currents until, with a current of 0·8 amp., the separation between the wings of the reversed line amounts to 0·13 cm.$^{-1}$. With the cadmium cathode the current could be increased to 0·4 amp. without reversal.

It may be concluded, therefore, that the structure observed by Mohammad and Sharma is a case of self-reversal due to the unsuitability of the vacuum arc source. The total structure width of the lines must be appreciably less than 0·050 cm.$^{-1}$

The peculiar absence of structure in these and other Ag I lines is explained in a forthcoming paper (*Proc. Phys. Soc.*) by Dr. Tolansky, who infers that it is due to anomalous external electron coupling, and not necessarily to zero spin or small magnetic moment.

Wheatstone Laboratory, W. E. WILLIAMS.
King's College, A. MIDDLETON.
Strand, W.C.2.
March 30.

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[1] *Indian J. Phys.*, 6, 75; 1931.

The 'Tail' of the Male American Toad, *Ascaphus*

Ascaphus (North America) and *Liopelma* (New Zealand) constitute, according to Dr. G. K. Noble, the Liopelmidæ, the most primitive anuran family in existence. Apart from the importance of *Ascaphus* from the general phylogenetic aspect, it has often been credited with possessing a tail. Noble has described a pair of tail-wagging muscles for the genus. Moreover, *Ascaphus* possesses a prepelvic skeletal structure of the nature of a prepubis (or epipubis) and is further notorious in possessing post-pelvic 'Nobelian cartilages' (Mehelij). Presumably the epipubis and the Nobelian cartilages represent chondrifications of the pre- and post-pelvic portions of the linea alba respectively. The latter are known in *Ascaphus* only.

The microtomised pelvic region of *Ascaphus* reveals the following features: (1) the frog has the epipubis in the form of an inverted Y, the arms of which are synchrondrotically fused with the pelvic girdle, whereas in *Xenopus* the epipubis is merely articulated with the girdle. Presumably the structure is a derivative of the linea alba as in *Xenopus*, whereas some Urodeles have a prepelvic element developing as a zonal derivative, and therefore not homologous with an epipubis. The Nobelian 'cartilages' *prove to be true bones* with enormous marrow cavities. Their ontogeny is unknown, but they look suspiciously like sesamoid bones (tendon bones). The cloaca is continued into the tail, at the end of which it has a groove-like opening. The cloacal opening has large dermal proctodeal glands. The 'tail' is a mass of spongiose fibres, the interstices of the network filled with blood. This erectile tissue is distributed into a pair of strands ventral to the cloaca and lateral to the Nobelian *bones*, and a strand is pierced by the cloaca. The skin is separated from the erectile tissue by large subdermal lymph spaces, but is adherent ventrally and mid-dorsally.

There is no doubt that the 'tail' of the male *Ascaphus* is an intromittent organ with highly developed erectile tissue comparable with that of the penis. If the genus is really very primitive, the cloacal region in the male may be of very great importance for the evolution of the omniote reproductive system.

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The Neuro-Muscular Junction and Curare

WHEN, some years ago, I suggested[1] that the phenomena associated with the action of drugs on muscle might more appropriately be explained by reference to the actual facts of minute anatomy than to a hypothetical 'neuro-muscular junction', what I had in mind was the histological conditions present at the eminences of Doyère and not the "part of the nerve which is exposed to the action of the drug, namely, its ending where the medullary sheath is absent". The situation, to which Prof. A. V. Hill refers in his article on "The Physical Nature of the Nerve Impulse",[2] is not materially different from any other node of Ranvier (it is only a node of Ranvier), and the axis core is here consolidated and compact. At the eminences of Doyère it is, on the contrary, considerably subdivided beneath the expansive surface of the sarcolemma, and is accessible to the action of drugs.

The result of Fromherz's experiment is consistent with this view, but scarcely with the view that curare acts on the part of the nerve mentioned by Prof. Hill, since numbers of precisely similar parts are contained within the length of nerve subjected to experiment after removal.

I make this comment on a detail of Prof. Hill's interesting paper because the point is capable of further development. The transformation of the nervous material from a dense to an attenuated state is carried a stage further within the muscle fibre proper, a fact which should receive more attention than has yet been accorded to it if the physical nature of the muscular contraction is to be understood in correlation with the actual mechanisms which subserve it and not merely in correlation with associated phenomena.

While it is desirable that the histological accounts of muscle and nerve should be pruned of their many inaccuracies and irrelevancies, may I suggest to Prof. Hill that the existence of what are called 'end-plates' is not dubitable by those familiar with muscle histology?

TUDOR JONES.

University of Liverpool.
April 8.

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[1] "Proceedings of the Anatomical Society." *J. Anat.*, **63**, 168, October, 1928.

[2] NATURE, **131**, 501, April 8, 1933.

Some Limiting Factors in the Environment of the Common Limpet, *P. vulgata*

THE relation of the organism to the environment, especially to limiting factors in the environment, is a subject of much importance to the student of bionomics, hence the following observations made in 1932 are considered worthy of record.

On the morning of August 28, 1932, at about the end of the period of hot dry sunny weather, dead, dying and weak limpets, *Patella vulgata*, were found at about high-water neap-tide level on a platform of cliff at Stepper Point, near Padstow. The dead and dying limpets (about 3 cm. long) were found both in and at the edge of healthy-looking pools which were lined by a pink encrusting calcareous alga (*Lithothamnion* or an ally). Around these pools and exposed to the air was a rim of white dead alga on which were numerous dead *Patella*, some having *dried-up* bodies. Suspicion that the pools may have been polluted—although pollution alone would scarcely suffice to explain the dead limpets on the rims—led to an examination of limpets at higher levels. It was then found that much larger limpets whose 'homes' were out of water were so weak that one could easily lift them off the rock slowly with a silver fruit-knife, whereas ordinarily a stout potato knife is barely strong enough to remove them even when plunged suddenly under the edge of the shell. The occurrence of these weak limpets enhanced the probability that the reduction in the level of the pools was natural, and led to the examination of more alga-encrusted pools in the locality, where more dead limpets were found, especially in the dried-up rims. There seems little doubt therefore that evaporation had exposed the rims of pools and the pool-limpets to the air. A few days later limpets in this locality—after immersion in sea-water during the increasing tides—were firmly seated on the rock.

The pools were situated at about the level of high-water neaps where usually the splash of the waves would renew the water even at neap tides, but on August 28 it is clear that the pools had remained stranded from some unusual cause, since many of the limpets had dried-up bodies. An explanation is suggested by an examination of the Admiralty Tide Tables and a consideration of local conditions.

The sea had maintained in the locality a continuous and arrestingly noticeable flat calm for some days previously; such light winds as occurred being offshore. It also happened that the period coincided (*a*) with low (summer) H.W. neap tides, August 25-28[1], and (*b*) with rather warm weather[2]. Thus the absence of renewal of the water extended over an unusually long and warm period and caused the limpets to be exposed to hot weather conditions at midday. It is known that limpets may not be wetted during a few successive neap tides in calm weather[3], but the exposure during a set of neap tides following the normal midday exposure at low water of spring tides would impose a severe strain upon the animals.

The death of the limpets on the rim of the pools therefore followed an unusual exposure to sun and air, while those succumbing in the pools had doubtless been subject to large and complicated variations in the little-known co-existing physical and chemical conditions[4]. At the same time limpets accustomed to exposure higher in the foreshore survived, though in a weak condition. These facts confirm the critical nature of the environment round about the level of H.W. neaps[5]. Limiting natural environmental conditions—unfortunately not closely definable—in temperature, humidity, certain chemical and other physical factors were therefore either approached or surpassed in this locality for *P. vulgata* in August 1932.

J. H. ORTON.

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University of Liverpool.
April 6.

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[1] Admiralty Tide Tables 1932.

[2] Daily Weather Report, British Section, Meteorological Office, London.

[3] J. H. Orton, *J. of Mar. Biol. Assoc.*, **16**, 279; 1929.

[4] J. R. Bruce, *Proc. and Trans. Liv. Biol. Soc.*, p. 19; 1931.

[5] J. Colman, *J. Mar. Biol. Assoc.*, **18**, 467; 1933.

Measurement of Light for Biological Purposes

THE measurement of light intensity has always presented certain difficulties to biologists, especially when it was necessary for the measurements to be made under field conditions. The available methods were either slow, or measured only limited spectral ranges, or else involved the use of cumbrous apparatus of limited portability. We have lately used, however, a form of apparatus which seems to be free from these disadvantages. We are so impressed with the usefulness and simplicity of this apparatus that we wish to bring it to the notice of readers of NATURE and particularly to that of biologists.

The essential part of the apparatus is a Bernheim photo-voltaic cell. The current produced by exposing this cell to light is measured by the deflection of a Unipivot galvanometer, which is sufficiently robust to be read easily in a small boat and has already travelled many hundreds of miles in a motor-car over bad roads. A manganin resistance of 1,000 ohms is put into the circuit for readings in full daylight. There is no lag in the readings and there is no dark current. Moreover, there is no reversal of the current at certain spectral ranges, as may be the case in some rectifier photo-cells.

Using this cell enclosed in a watertight container we obtained the following measurements of light penetration in Windermere. For comparison with the figures so obtained are given those measured with a recent form of potassium-on-copper vacuum cell. In using the latter, it is necessary to amplify the primary photoelectric current about two hundred times in order to obtain readings comparable with those of the Bernheim cell. The thermionic potentiometer devised to accomplish the amplification and measurement is naturally somewhat bulky and less readily portable.

Light intensity at different depths in Windermere.
February 8, 1933.

Depth in m.	1	2	3	5	7	9	11	13
Bernheim cell	38·0	19·9	11·1	3·84	1·33	0·45	0·15	0·052
Vacuum cell amplified	36·3	15·9	7·41	1·82	0·43	0·11		

Values as percentages of full daylight.

The greater utility of the Bernheim cell for this type of work is due not only to its greater sensitivity but also to the fact that it is sensitive over the whole range of the visible spectrum. The cell we have employed for outdoor work has the following spectral sensitivity, given as galvanometer deflection per 1,000 ergs per cm.^{2} per sec. (for the facilities necessary to make these determinations we are indebted to Prof. R. Whiddington):

Wave-length in A.	3500	4200	5000	5700	6200	7000
Sensitivity	1·4	3·0	5·6	6·7	4·8	1·1

The vacuum cell used in the above mentioned measurements has a maximum sensitivity in the region 4000–4900 A. and only slight sensitivity in the red.

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Preservation of Fossil Bones

UNDER the above heading in NATURE of March 11, p. 366, Mr. Ludovic McL. Mann states that the mammalian bones in the Kelvingrove Museum, Glasgow, "were all found . . . in the laminated gravels of the old raised terrace of the Kelvin river, some eight miles east of Glasgow, at about 170 ft. O.D."

Readers will probably interpret "raised terrace" as they are accustomed to interpret raised beach, that is, as a terrace originally formed at a lower level and owing its present position to relative elevation of the land. Certainly they will think that the gravel deposit in which the bones were found is a *higher* terrace of the River Kelvin, in the same way as the implementiferous terraces of southern England are higher terraces of the rivers occupying the valleys.

Recently, I have been studying the Kelvin valley terraces in an attempt to understand the glacial history of the Glasgow district. I think, with other geologists, that there is no connexion between the 170-ft. terrace of current-bedded sands and gravels and the present River Kelvin, other than that they occur in the same valley, referred to above as the Kelvin valley.

The late Prof. Gregory[1], on more than one occasion, gave a Mousterian age to the gravels of these terraces, but it is now clear that they must be very much more recent than the Early Magdalenian.

W. J. MCCALLIEN.

University of Glasgow.
April 1.

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[1] cf. Gregory, J. W., and Currie, E. D., "The Vertebrate Fossils from the Glacial and Post-Glacial Beds of Scotland in the Hunterian Museum, University of Glasgow, and their Evidence on the Classification of the Scottish Glacial Deposits", *Monographs of the Geological Department of the Hunterian Museum, Glasgow University*, 1928, p. 20.

Research Items

Woolly Hair in a Nordic Pedigree. An interesting case of an apparent mutation in hair character inherited as a simple Mendelian dominant through five generations in a Norwegian family has been described by Dr. O. L. Mohr (*J. Hered.*, vol. 23, No. 9). The hair is woolly or ulotrichous and short, closely resembling that of a negro but densely set. The individuals are otherwise of Nordic type and colouring, and all the circumstances render any crossing in the ancestry highly improbable. The descent is from a woman who married twice and left woolly-haired individuals in both lines of descent, the sibships numbering 38 woolly, 42 non-woolly and 3 unknown. The parents and grandparents of this woman are known, but not their hair characters. The woolly hair is flattened or kidney-shaped in cross-section and shows only traces of a medulla. It only reaches the length of negroid hair but is light in colour. This appears illuminating in regard to the origin of the ulotrichous races of mankind, as such hair is also dominant in racial crosses. The similarity cannot, however, be pressed too far, since in negro crosses the later generations show various degrees of the woolly condition. Nevertheless it helps to indicate how the ulotrichous character may have arisen, possibly independently, in Negro and Melanesian.

Destruction of Predatory Animals in Alaska. The past five years have shown in Alaska an increased destruction of predatory animals owing to the assistance and advice given to trappers by the local control leader of the Bureau of Biological Survey (Report for year ended June 30, 1932). In the year before control work was undertaken, 1925–26, 1,111 wolves and coyotes were presented for the 15 dollar bounty, and in 1927–28 the number was 2,161. In 1929–30, notwithstanding that the legislature reduced the bounty to 7.50 dollars on wolf and 5 dollars on coyote, there were 2,304 individuals presented. In 1931, with the bounty re-established at 15 dollars, though fewer private trappers worked in the Territory, reports to the Bureau show an increase in the catch over the preceding year of nearly 70 per cent.

Penguin Embryos. C. W. Parsons has described the series of penguin embryos, 64 of the gentoo and 14 of the ring penguin, collected by the "Discovery" Expedition (Reports, vol. 6, 139–164; 1932). The earliest embryo corresponds with an embryo of the fowl of 24 hours incubation; the latest is a ring penguin about six inches long, fledged in the coat of silky down with which it hatches. The intervening embryos are arranged in six stages. A description of the more outstanding features of each of the eight stages is given and is followed by comparative studies on the brain, feathers, and cartilaginous skeleton. In the brain, one of the notable features is the precocious development of the pineal body and for a time its disproportionate size. The last feather rudiments to appear are those on the wings. The author comments on the controversy as to whether feathers can be derived, like scales, from conical skin papillæ and refers to the granular type of skin reproduced in the earliest feather papillæ "as being a likely characteristic both of the ancestors of birds and of the scaly reptiles". In the skeleton the cartilages of the fore-limb grow at a prodigious pace. The author remarks that the body of the penguin, with its back arched and its limbs hanging vertically, is extraordinarily reminiscent of the aquatic reptiles of Mesozoic age. Small transitory papillæ which appear on the dorsal side of the lung are interpreted as incipient air-sacs which do not proceed with their development; air-sacs in that position would be hemmed in between the distended lung and the unyielding dorsal wall of the cœlomic cavity and in time would be eliminated. The development of the heart is traced in some detail. The paper is illustrated by text figures and by six admirable plates.

Tintinnids of Mutsu Bay. Much of the fauna and flora of Mutsu Bay has been described already systematically in the Science Reports of the Tôhoku Imperial University (Reports of the Biological Survey of Mutsu Bay). Vol. 8, No. 4, November 1932, contains the Stomatopoda, Cirripedia and the pelagic Ciliata, suborder Tintinnoinea. The last, by Yoshine Hada, includes a large number of species obtained by the author himself in surface collections and vertical hauls at numerous stations, August 1929–September 1930, and plankton collected with a surface tow-net twice a month in 1927–31 and preserved in the Asamushi Marine Biological Station of the Tôhoku Imperial University. Tintinnids form a very important part of the unicellular plankton and their importance is being recognised more and more, for they are the food of innumerable small marine animals swimming in the surface layers, from Protozoa to young fishes. From this region, thirty-four species belonging to twelve genera and eight families are recorded, seven species being new to science. The most predominant genus is *Tintinnopsis*. Some of the genera *Tintinnopsis* have a wide distribution and such a well-known species as *Tintinnopsis beroidea*, common in British waters, abounds in Japanese seas in February–April and September. The family *Tintinnidæ*, the members of which assume comparatively large dimensions in warm waters, is represented by only four species, but three of those recorded are common, including a new *Tintinnus* closely related to *Tintinnus tenuis* Kofoid and Campbell, and both of these occur abundantly. The paper is illustrated by clearly drawn text figures of the lorica of most of the forms.

Root Systems of Fruit Trees. The results of modern research are revealing many striking facts about the extent of the root systems of various plants. Older ideas about shallow-rooted and deep-rooted plants do not seem to hold. A recent paper by Mr. W. S. Rogers ("Root Studies III", *J. Pomol. and Hort. Sci.*, 11, No. 1, 1–18, March, 1933) shows not only that the roots of gooseberries penetrate the soil to a depth of 8 ft. but also correlates root development with manurial treatment. Pears and black currants were also studied. Roots of the former reach a depth of 11 ft. and of the latter 7 ft. Pears grafted on seedlings were compared with those grafted on Angers quince. The seedling roots consisted of a large number of main roots going almost vertically downwards, whilst quince roots form a horizontal 'scaffolding' from which fine roots descend. Heavy manuring with farmyard manure increased the total amount of root produced, but tended to make the system more compact.

Plant Geography of Ulijanowsk. This part of Russia in Europe lies south of the middle reaches of the Volga. The variation in natural conditions within this area causes great diversity in the vegetative covering. Most of the forests are pine, or subsidiaries resulting from felling, and are classified into the *Pinetum querceto-tiliosum* type growing on the higher and wetter places, and the *Pinetum querceto-sub-stepposum siccum* type. The composition of these forests and the undergrowth, including the grassy soil covering, has been examined by H. Grosset (*Bull. Soc. Nat. Moscou*, 41, Nos. 1–2). The study terminates with a short discussion on the steppe vegetation. The author emphasises the value of a consideration of the vegetation of areas in schemes of agricultural development. Water is the limiting factor in crop production, and, as the same amount of rainfall may give different effects according to the nature of the soil, the vegetation is suggested as a means of detecting biologically equivalent areas.

Land Bridges of Gondwanaland. In the *Bulletin of the Geological Society of America*, 1932, Prof. C. Schuchert deals with Gondwana land bridges (pp. 875–915), and his discussion is followed by a paper on isthmian links by Prof. Bailey Willis (pp. 917–952). Both papers are admirably illustrated by coloured maps. As the result of some thirty years' study of the palæontological evidence, Schuchert concludes that (*a*) the marine life of southern North America and southern Europe, and of South America and Africa, from the Silurian to the end of the Miocene; (*b*) the distribution of the land plants and animals from the Permian to the Cretaceous; and (*c*) the discontinuous localisation of recent life in Africa and South America, are overwhelmingly in favour of the existence of the Gondwana land bridge up to the end of Cretaceous time. The submergence of the bridge is thought to have taken place from the Eocene to the close of the Miocene, and it is considered likely that during this time there may have been a South Atlantic archipelago. Willis discusses the orogenic processes that may have been responsible for the formation of bridges such as the Isthmus of Panama, arguing from this particular case that marginal upthrusting has been due to expansive forces originating in adjoining basins and deeps. Similar "isthmian links" of the past are traced between Africa and India; Asia and Australia; and Africa and Brazil, along the lines of present-day submerged ridges and island chains. Assuming some general cause of moderate refrigeration, an attempt is made to show that the diversity of Permian climates in the northern and southern hemispheres is not inconsistent with the atmospheric and oceanic circulations controlled by the postulated "isthmian links" of that period.

Katabatic Winds. In spite of all that has appeared during the past few years dealing with katabatic winds, there is evidently still a large field of research into these and other winds that arise during the night when cooling of the lower layers of the atmosphere tends to isolate them from the upper 'free' atmosphere. S. Atmanathan (India: Meteorological Department. *Scientific Notes*, vol. 5, No. 46: Calcutta: Government of India Central Publication Branch, 1932; 10 annas; 1*s*.) describes the occurrence at Poona of a curious type of squall which he calls a solitary gust. These are sudden onsets of wind from the direction of the gradient wind that interrupt intervals of calm separating periods during which katabatic winds are blowing, and last from three to fifteen minutes. In most cases the squall is accompanied by a slight rise of pressure, and no subsequent fall; temperature generally falls temporarily during the squall, sometimes by so much as 4° F. This is a very unusual accompaniment of a sudden increase of wind on a clear night, and seems to rule out the possibility that the effect may be due to the gradient wind suddenly undercutting the cold surface layers. The author makes a tentative attempt to explain matters with the aid of mathematical dynamics, following Margules, but it is doubtful whether the observational material is complete enough for this, to mention only one obstacle to such an undertaking. Another difficulty of explanation arises from the fact that the usual direction of the gradient wind agrees roughly with the trend of the valley. He seems justified, however, in concluding that the phenomenon is in some respects analogous to a tidal bore—a surge of colder air of slightly higher pressure up the valley from the regions fed by the normal katabatic wind.

Anomalous Absorption of γ-Rays. B. Arakatsu has made (*Mem. Sci., Taihoku Imperial University*, Dec. 1932) an interesting suggestion to account for the anomalous absorption of γ-rays, observed by Tarrant, Chao, and others as an excess absorption for the heavier elements over that predicted by the Klein-Nishina formula for electronic absorption. This excess has usually been regarded as nuclear in origin. Arakatsu ascribes the effect to the extranuclear electrons, and he suggests that the rest-energy of these electrons may be capable of quantum jumps. He regards the electrons as wave-mechanical systems the energies of which may be calculated like those of a two-dimensional oscillator. The electrons taking part in the process are supposed to be those lying within a radial distance of the nucleus which is less than a half wave-length of the quantum radiation from a 'jumping electron'. The density of these electrons is obtained by the method of Thomas and Fermi, and the additional absorption is found to vary with the atomic number in fair accord with experiment.

Effects of the Addition of Tellurium to Lead. A paper read by Messrs. W. Singleton and Brindley Jones before the Institute of Metals on March 8 dealt with the chemical and mechanical effects of the addition of tellurium to lead to the extent of say 0·07–0·10 per cent. It is shown that such alloyed lead has a greatly increased resistance to attack by sulphuric acid, actual plant tests indicating that the loss of weight is only one-seventh of that of the most resistant chemical lead hitherto produced. Chemical lead is known to recrystallise spontaneously after strain at room temperature, and cannot, therefore, be hardened in that manner. With more than about 0·1 per cent. of tellurium, the product shows no softening through cold rolling after 140 days, with the result that tensile strengths up to about 4,000 lb. per sq. in. can be obtained in cold-rolled sheets. The degree of ductility associated with this tensile strength is good. On annealing after cold work the alloyed lead shows a relatively very fine crystal size as compared with that for the lead itself. The alloy can be extruded normally when both the strength and elongation are distinctly greater than those of the pure metal, and with slow rates of straining the elongation may approximate to 100 per cent. The fatigue limit of the tellurium-lead is of the order of ± 0·5 tons per sq. in., nearly three times that of ordinary lead. Tests made on the resistance of pipes to bursting by frost, showed that the addition of tellurium greatly improves the material. It is stated, though no actual results are given, that the addition of tellurium to lead alloys exerts similarly beneficial effects.

Sewage Purification by a New Process. The problems of sludge disposal and effluent purification are still troubling inland municipalities in most civilised countries, and though this century has seen many improvements in detail, the broad problems remain unsolved. A novel process has recently been developed in New York, which originated in the desire of Messrs. Guggenheim Brothers to find a new outlet for sodium nitrate. The desire has not been fulfilled, but G. H. Gleason and A. C. Loonam, on behalf of the firm, have succeeded in devising a system of purification and disposal that demands the attention of all concerned. The principles of their system consist in clarifying the sewage by precipitation with ferric sulphate and lime, filtering and burning the sludge, recovering the ferric sulphate by treating the ash with sulphuric acid, and purifying the effluent by means of the base-exchange material, zeolite. During the precipitation process, air is passed continually through the liquid to keep the iron in the ferric state, and careful control of the hydrogen ion concentration, at pH 6–8, is essential for success. Ferric iron, followed by lime, was found to be the best precipitant. In the base-exchange process, the basic nitrogen in the organic compounds present in the effluent is exchanged for the sodium in the zeolite, and when the latter is spent, it is regenerated by washing with a 20 per cent solution of sodium chloride. The nitrogen compounds in the brine are decomposed by distillation with lime and the ammonia is recovered, whilst the purified brine becomes available for further use. Tests on a plant treating 2,500 gall. of crude sewage a day have given excellent results, and a plant of ten times this capacity is now being installed at Chicago. The proprietors of the process are sanguine that capital and operating costs will compare very favourably with those of existing processes.

Astronomical Topics

Periodic Comet Pons-Winnecke. This comet attracted much attention in 1921 and 1927 from its near approaches to the earth, the least distances being 12 and 3½ million miles. Since 1927, it has made a close approach to Jupiter, which has increased the perihelion distance by six million miles, so that there will be no more approaches to the earth so close as that of 1927, which was the second closest approach on record; the closest was Lexell's comet in 1770, the distance being 1½ million miles; but this proximity was not known until later.

The first to observe comet Pons-Winnecke at this return was Dr. A. Wachmann at Bergedorf; the following two positions were obtained there from photographs taken with the Lippert astrograph (*Beob. Zirk.* No. 12):

U.T.	R.A. (1933.0)	N. Decl.	Mag.
March $24^{d}2^{h}55{\cdot}0^{m}$	$17^{h}44{\cdot}0^{m}$	9°27′	14
25 2 2·6	17 47·3	9 22	14½

The indicated date of perihelion passage is about May 18·7; the comet will be nearest to the earth about the same time, its least distance being about fifty million miles; it should be within reach of moderate instruments this month. As the period is now 6 yr. 1 mon., there is likely to be a closer approach in 1939 than this year.

Photographing the Moon's Shadow on the Earth during the Eclipse of August 31, 1932. *Popular Astronomy* for April contains an article by W. M. Browne, of the U.S. Naval Observatory, Washington, in which he describes a successful attempt to photograph this shadow from an aeroplane, which was just outside the southern limit of totality. A cinematograph was used; at the beginning and end of the exposure, the camera was directed to a chronometer, so that the accurate time can be deduced for each part of the picture; the focus was altered before directing it to the ground. It was noted that one of Baily's Beads remained visible throughout, showing that the aeroplane was almost on the limit, but just outside it. To the eye, no definite edge of the shadow could be seen on the ground, but on developing the film it was found that some details on the landscape could be seen before and after totality, becoming invisible during totality, which lasted 9·4 sec. at the region photographed. As the predicted time was 14 sec., it is concluded that the predicted southern limit was 0·4 mile too far south; also mid-totality was later than the predicted time by 3·8 sec. The region was the town of Suncook, New Hampshire, six miles south-east of Concord.

Motion of the Spiral Nebulæ. The presidential address to the Royal Astronomical Society on this subject by Dr. Knox Shaw has now been published (*Mon. Not. Roy. Ast. Soc.*, Feb. 1933). When the first determinations of radial velocity were made, the high speed of the sun due to galactic rotation was not applied; this accounts for most of the approaching velocity found in the case of the Andromeda nebula. Early discussions seemed to indicate that the galactic system had a velocity relatively to the mean of the spirals of some 200 km./sec. towards the direction of Capricornus, as seen from the sun. However, when the correction for galactic rotation is applied, our own galaxy seems to have a small velocity referred to the mean of the others. This is not unexpected, since our galaxy seems to be unusually large and massive. The value actually adopted for the solar motion (due to de Sitter) was 286 km./sec. towards R.A. 314°, N. Decl. 66°. One rather surprising point is that the red spectral shift has an appreciable effect on the photographic magnitudes of the nebulæ, amounting to a quarter of a magnitude for the distant ones. It might have been expected that the shift would bring some ultra-violet spectrum into the visible region; but these nebulæ do not appear to have an ultra-violet spectrum strong enough to register on the plates.

Dr. Knox Shaw estimated the average peculiar motion of the nebulæ as about 140 km./sec. He also suggested that the individual members of the clusters of spirals are considerably fainter (some 0·9 magnitude) than isolated spirals. But more evidence is needed before this can be received with confidence.

Copepods of Woods Hole*

DR. CHARLES BRANCH WILSON has recently published a beautiful and important monograph which he dedicates to the late Richard Rathbun, assistant secretary of the Smithsonian Institution from 1897 until 1918*. This is a study of marine, brackish-water and fresh-water species of copepods, including those that are free-swimming, commensal, semi-parasitic and parasitic. The area studied is large, including the whole of Cape Cod, Mass., and all the islands south of it and those portions of the surrounding ocean between latitude 40° and 42° N. and between longitude 69° and 72° W. It lies at the latitude where the northern and southern faunas meet and overlap, and therefore contains representatives of three distinct plankton faunas, those of the area itself, especially of the ponds and beach sands which make up the bulk of the species, the northern species brought by currents from the Bay of Fundy, the Gulf of the St. Lawrence or even farther north, and the southern species brought from the tropical Atlantic and the Gulf Stream.

The number of species previously reported from the area is 148. The present work increases this to 373 including 178 genera, several of which are new, and there are many new species. It is based mainly on a collection made in this area by the late Dr. Rathbun during the summers and early autumns of the years 1881–85 inclusive. Some of the specimens were obtained by surface towing and the rest were taken during the trawling and dredging operations carried on by the steamers of the Bureau of Fisheries, the *Fish Hawk* and *Albatross*. In addition there is the entire collection of local copepods made by the Bureau of Fisheries, collections from fresh-water, brackish-water and salt-water ponds made by Dr. Rathbun and continued by Dr. Wilson and many specimens from the beach sands. The whole forms a unique collection which is specially valuable on account of the notes, particularly colour notes, made by Dr. Rathbun when the animals were still alive, many of the copepods having only been described previously from preserved specimens.

There are new records of numerous species which are only taken very early in the morning or late at night and an important addition to the 'gear' was a device known as the 'trawl wings' attached to the bean trawl which captures the small free-swimming animals often living in extreme abundance just above the bottom. Dr. Rathbun's dissections, microscopic preparations and drawings were also of much use, but this monograph could not have been written unless the author himself were an expert on the subject. Dr. Wilson is well known as such an expert and there is a large amount of his own work here and much that is original. A clear account is given of so many groups illustrated with neat text figures and plates that the volume may well serve as a textbook to workers in all lands, including as it does representatives from almost every copepod family with a large number of species figured and described and useful keys to the sub-orders, genera and species.

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* Charles Branch Wilson. "The Copepods of the Woods Hole Region, Massachusetts." *Bull.* 158, *U.S. Nat. Mus.*, Smithsonian Institution, Washington, D.C., 1932.

Amino-Acids, Proteins and Proteolytic Enzymes

By PROF. MAX BERGMANN, University of Dresden

II

THIS is perhaps a suitable moment at which to assess our knowledge of the proteolytic enzymes. It remains a fact that dipeptidase, aminopolypeptidase and carboxypolypeptidase are three distinct enzymes; for the present, we may retain these names, but only so long as we bear in mind that they do not truly express the characteristic properties of the enzymes. We have seen that there is a dipeptide of naturally occurring amino-acids (asparagyltyrosine) which is not attacked by any intestinal proteolytic enzyme; there is a dipeptide (tyrosyltyrosine) which is hydrolysed not only by dipeptidase but also by carboxypolypeptidase; finally there are dipeptides (glycyl- and alanyl-proline) which are resistant to dipeptidases but are attacked by polypeptidase. It is therefore clearly not the number of amino-acids in the molecule of a peptide which determines its susceptibility to a particular peptidase. The presence of free amino and carboxyl groups adjacent to the peptide linkage does not necessarily render the compound open to attack by dipeptidase, nor will aminopolypeptidase hydrolyse all peptides in which the peptide linkage adjoins a free amino but no free carboxyl group. On the other hand, the action of the latter enzyme is not always inhibited by the proximity of a free carboxyl group to the peptide linkage.

It is evident that we must take further circumstances into consideration before we can hope to define rigidly the conditions of action of the various peptidases; in particular, careful attention must be given to electro-chemical effects and to such structural features as the secondary or tertiary nature of the nitrogen participating in the peptide bond. The accumulation of facts bearing on this question will be a major object of future work; this work can be undertaken hopefully now that the benzylcarbonato method affords a means of obtaining almost any peptide which may be desired.

From still another point of view, it has been possible to gain an insight into the structural and electro-chemical conditions which regulate the enzymic hydrolysis of peptides, namely, by experiments concerning the transformation of proteins into non-nitrogenous compounds. Hitherto, it has been thought that this transformation could only take place by way of the individual amino-acids themselves, which were supposed to undergo dehydrogenation and subsequent hydrolytic loss of nitrogen with formation of a ketonic acid.

At the time when we began experiments bearing on this point, no enzyme had been discovered which was capable of dehydrogenating amino-acids. For reasons which need not be discussed here, the idea occurred to us that such a dehydrogenation might be accomplished at the peptide stage. In order to test this hypothesis, a number of unsaturated di- and tri-peptides were synthesised and a search was made for an enzyme which might be capable of hydrolysing these compounds. An enzyme was in fact obtained from kidney[9] which attacked glycyldehydrophenylalanine with the production of glycine, phenylpyruvic acid and ammonia; the same enzyme also attacked glycyldehydroalanine with analogous results:

$$C_6H_5.CH:C(NH.CO.CH_2.NH_2).COOH \longrightarrow CH_2.NH_2.COOH + C_6H_5.CH_2.CO.COOH + NH_3$$

Glycyldehydrophenylalanine is completely resistant towards dipeptidases of plant and animal origin, amino- and carboxy-polypeptidase, trypsin and pepsin. On the other hand, the kidney enzyme is quite unable to attack glycylphenylalanine. It is clear therefore that the kidney enzyme is no ordinary dipeptidase but is indeed specifically adapted to the hydrolysis of unsaturated peptides.

The fact that glycylphenylalanine and glycyldehydrophenylalanine, two peptides which differ only by two hydrogen atoms, should require distinct enzymes for their hydrolysis, is of great importance in relation to the conditions of action of the various peptidases; it indicates that a compound may possess all the characteristics (a normal peptide linkage adjacent to free amino and carboxyl groups) hitherto regarded as essential to a substrate for dipeptidase and may still fail to be hydrolysed by this enzyme.

The existence and properties of the kidney dehydrodipeptidase have also important physiological implications, since they demonstrate a possible mechanism of deamination of protein degradation products in the body; moreover, the process involves the simultaneous formation in the kidney of keto-acids and ammonia, which are well known to occur in the urine in considerable quantities under certain conditions. It appears that the kidney, through its possession of this enzyme, may play a definite part in protein metabolism, particularly if we may assume that unsaturated peptides or related compounds of unsaturated amino-acids are produced in the course of renal metabolism. The likelihood of the latter assumption is indicated by the work of Krebs[10] who has shown that the kidney is capable of dehydrogenating amino-acids and peptides; in these experiments, however, the action of the kidney was not confined to the naturally occurring amino-acids but extended to their optical enantiomorphs, and it is therefore too early to say whether the results are of true biological significance.

Up to the present point, we have been dealing with the synthesis of new peptides and their behaviour towards enzymes. We must now pass on to consider the various conclusions, which experiments of this type enable us to draw, concerning the structure of the natural proteins themselves. This matter can best be exemplified by a consideration of the position occupied by proline in the natural proteins in the light of the behaviour of synthetic proline peptides of known structure[11].

The process of enzymic hydrolysis of a protein must be pictured as the successive scission of peptide linkages; this being so, it is natural to assume that every such scission will involve the liberation of an amino and a carboxyl group. The carboxyl groups liberated during digestion can be readily determined by titration in alcoholic solution by the method of Willstätter and Waldschmidt-Leitz, and the amino groups by the method of van Slyke. The course of enzymic digestion of many proteins has been followed with the aid of these methods and it has invariably been found that amino and carboxyl groups are liberated in equivalent amounts; in spite of the fact therefore that various authors, for example, Emil Fischer himself, have discussed at different times the possible occurrence of other than normal peptide linkages in proteins, no analytical evidence of the existence of such other linkages has been obtained, and the liberation of amino and carboxyl groups in equivalent amounts has indeed been taken as a criterion of true proteolysis.

Now we have already discussed two synthetic proline peptides, glycyl- and alanyl-proline, which are peculiar in that they are hydrolysed by amino-polypeptidase but not by dipeptidase; moreover, the hydrolysis of such a peptide, when it does occur, will give rise to liberation of a free carboxyl group but not of an amino group; in this case, therefore, the accepted rule of equivalent liberation of amino and carboxyl groups evidently does not apply. This fact can be utilised to throw light upon the mode of combination of proline and hydroxyproline in gelatin.

Proline can clearly occupy three distinct positions in the peptide chain of gelatin: (1) it may be attached through its carboxyl group to the amino end of the chain; (2) it may be attached through its imino group to the carboxyl end; (3) it may lie inside the chain, and be linked through its carboxyl and imino groups. The second and third of these possibilities involve the existence of linkages similar to that of glycylproline, and it is therefore possible, by comparing the action of proteolytic enzymes on gelatin and glycylproline, to decide whether this type of linkage is indeed present in gelatin or whether the proline is combined in the protein molecule entirely through its carboxyl group.

In order to test this question, gelatin has been submitted to digestion with trypsin followed by intestinal peptidase. Tryptic digestion causes rapid and equivalent increases in free amino and carboxyl groups whilst the peptidases cause a predominant increase in free carboxyl. Reference to the results obtained in the enzymic hydrolysis of the proline peptides will make it clear, therefore, that a large part at any rate of the proline (and perhaps also of the hydroxyproline) of gelatin must be combined through its imino group.

These experiments provide an example of a protein digestion in which free amino and carboxyl groups are not liberated in equivalent amounts; such equivalence can therefore no longer be regarded as an essential characteristic of proteolysis. Furthermore, they show in a convincing manner the importance of the individual constituent amino-acids in determining the behaviour of a protein towards enzymes; owing to the structure of proline the peptide chain is heterogeneous at those positions where proline is linked through its imino group, and this heterogeneity forces the process of enzymic degradation of the protein to follow a certain course.

We may now pass from the amino-acids, peptides and peptidases to a brief consideration of the enzymic degradation of complete proteins. Very little is known of the enzymes (proteinases) which are able to attack proteins of high molecular weight, but the action of these enzymes is of great importance; not only are they responsible for the first stages of the digestion of all protein taken in the food, but also there are industrial processes of the first importance which depend on the enzymic digestion of proteins.

A serious difficulty in the investigation of proteinase action is that these enzymes often have to work in heterogeneous systems, since the substrate may be largely undissolved, and hence the simple rules of mass action cannot be applied; the variable magnitude of the surface of the protein exposed to enzymic attack complicates the situation so that the curves representing the course of action of proteinases on undissolved proteins are not susceptible of simple interpretation.

In the case of gelatin the problem can be simplified to some extent by using the protein in the form of films of uniform size and thickness, so that the surface of protein remains practically constant during digestion; moreover, the course of the digestion can be conveniently followed optically if a black insoluble substance be previously distributed evenly through the gelatin, so that it gradually passes into the aqueous phase as digestion proceeds. With the aid of this method it has been found that the course of digestion of gelatin is represented by the simple formula: $x = kt\sqrt{E}$, where x = digestion (per cent); k = constant, t = time, E = enzyme concentration (per cent).

This formula is valid during the whole of the process of digestion, and for concentrations of enzyme varying from 0·0001 to 0·1 per cent and more. Thus apart from variations in the surface exposed, it may be stated that the rate of digestion of a protein is proportional to the time and to the square root of the enzyme concentration, but is not affected by the total amount of enzyme or of protein[12].

The same rule applies to the digestion of fibrous collagen, at least during the first third of the digestion period, provided that precautions are taken to prevent the inactivation of the enzyme. The validity of the formula in the case of collagen is at first sight surprising, since it might be expected that the fibres would become thinner during the digestion and that the surface would then be altered. The only explanation of the constancy of the rate of digestion actually observed seems to be that digestion of the collagen fibres proceeds only from their ends. That this is indeed the case is shown by the fact that the rate of digestion of true skin is proportional to the area of the external surface in which the ends of the collagen fibres lie.

The key to present-day and future protein chemistry lies in the development of new synthetic methods, and this is the justification for the expenditure of so much time and labour on the improvement of such methods. In these lectures I have described technical advances made during the last few years in my laboratory, which have thrown some new light on the specificity of the proteolytic enzymes, at the same time extending our knowledge of normal and pathological protein metabolism. With the aid of the combined efforts of enzyme chemistry and organic synthesis, we may reasonably hope that these advances will be continued.

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[9] Bergmann and Schleich, *Z. physiol. Chem.*, **205**, 65; 1932: **207**, 235; 1932: Bergmann and Grafe, *Z. physiol. Chem.*, **187**, 187; 1930: Bergmann, Schmitt and Mickeley, *Z. physiol. Chem.*, **187**, 204; 1930.

[10] Krebs, *Klin. Woch.*, **11**, 1744; 1932.

[11] Bergmann, Zervas and Schleich, *Ber. deutsch. chem. Ges.*, **65**, 1747; 1932.

[12] Bergmann and Föhr, *Biochem. Z.*, **250**, 568; 1932.

University and Educational Intelligence

CAMBRIDGE.—In his will, Mr. F. E. Elmore, who died last year, bequeathed the income of a trust fund for the provision of scholarships for medical research to male post-graduates of British or Colonial birth at the University of Cambridge.

Prof. A. C. Seward has announced the gift of 6,000 sheets of mounted and named British plants to the University Herbarium by Mr. J. E. Little, of Hitchin.

A University lecturer and a University demonstrator in physics will be appointed shortly. Further information can be obtained from Mr. H. Thirkill, Clare College.

The Buildings Syndicate recommends that the plans prepared by Mr. Lodge for an extension to the Botany School be approved and that the tender of £13,652 from J. Parnell and Sons for the work be accepted.

C. F. A. Pantin, of Trinity College, has been approved for the degree of Sc.D.

EDINBURGH.—Prof. Ivan de Burgh Daly, professor of physiology in the University of Birmingham, has been appointed professor of physiology in succession to Sir Edward Sharpey Schafer, who will retire on September 30.

LONDON.—The following grants have been made to the University, payment being spread over a period of years: Haberdashers' Company, £500; Saddlers' Company, 500 guineas; and Apothecaries' Society, £500. A small donation has also been made by the Glass-sellers' Company, which expressed its desire to be associated with the Bloomsbury scheme. These benefactions will be applied towards meeting the cost of the new Ceremonial Hall to be erected on the University's site in Bloomsbury.

IT is announced by the New York correspondent of the *Times* that Dr. James B. Conant, Sheldon Emery professor of organic chemistry at Harvard University, has been made president of the University in succession to Dr. A. Lawrence Lowell, who has resigned.

THE report of the University of Leeds on the session 1931–32 shows that the number of students as a whole and in the various faculties was well maintained despite its having been a time of severe retrenchments of expenditure. Of the 1,520 full-time students (including 367 women) 1,197 were from Yorkshire homes, 24 from other English counties, 54 from India, 12 from Wales, 12 from Egypt and 34 from other countries. Their distribution by faculties was: arts 45 per cent, medicine 24, pure science 14, technology (engineering, mining, coal, textiles, dyeing and leather industries) 14, agriculture 3. Of the students who graduated in 1931, not more than eight per cent were known to be unemployed by December of that year but "there are signs during the current year that greater difficulties than formerly may be experienced in placing our graduates". In a separate pamphlet is given a list of 215 publications (chiefly in science and technology) by members of the University, and abstracts of theses (also chiefly in science and technology) accepted for higher degrees. In the course of the year, the Clothworkers'

Company renewed its grant of £3,000 a year for research in textiles, in addition to the £3,000 for the Textile Industries and Colour Chemistry Departments. Quite recently the University authorities have announced that a discovery made in the Textiles Department by a Swedish investigator, Mr. Hellberg, of a new type of wool pack, is likely to obviate losses of many thousands of pounds suffered annually through contamination of wool packed for shipment. An outstanding event of the year was the institution of a new chair, of the philosophy and history of religion, for which an endowment of £20,000 was provided under the will of Mrs. Emily Fawcett.

Calendar of Nature Topics

Indian Hot Weather

The year in India is divided into three seasons: the cold weather, the hot weather, and the monsoon. The cold is relative, for even in January the average temperature over the whole Indian land area is 67° F., but the hot weather, which begins in April and continues into June, is extreme. The climax comes in May, when the average of the twenty-four hours exceeds 90° F. over the greater part of the interior, and the day temperature regularly exceeds 100° F. over half the country. There is a considerable daily variation, but in many places the thermometer remains above 80° F. throughout the night. The air is dry and dusty, and the ground is baked hard. Early in June, before the monsoon breaks, the climate is even more oppressive, for the heat continues unabated while the air becomes moister and more sultry. The first steady rains bring an appreciable fall of temperature and are eagerly awaited.

An Experiment in Direction Finding

On May 15, 1900, there began one of the most instructive of experiments on the locality sense of birds. "Twelve noddies and twelve sooties [terns belonging to the species *Sterna stolida* and *S. fuliginosa*] were captured on Bird Key on May 15. The next day they were sent to Key West and, on May 17, put aboard a freight steamer for Galveston. The cages were hooded and, except at feeding time, the birds had no chance of seeing anything which would give them their bearings. On the night of May 20 two birds (both noddies) were released but neither returned to their nests.

"On May 21, at 8 a.m., four noddies and six sooties were released; at 7 p.m. two more noddies were set free under extremely difficult conditions, as a heavy rain began falling that night which continued without interruption all the next day. Of the twelve released five noddies and five sooties returned.

"During the morning of May 23 the remaining birds, four noddies and six sooties, were fed and freed in Galveston Harbor, 855 miles west of Bird Key. Of these ten, one noddy and two sooties reached their nests."

With reference to this last test, the experimenters, Drs. J. B. Watson and K. S. Lashley, pointed out that the failure of so many birds to return was not surprising in view of the numbers of hawks frequenting the Texas shore, and the tired condition of the terns after their eight days' confinement.

Conclusions regarding Homing Sense of Terns

The experiments, of which one has been described above, took place in the Gulf of Mexico, where regularly towards the end of April, a great colony of noddy and sooty terns arrives at Bird Key, one of the islands in the Tortugas group. The experimenters regarded the results of their many tests of the homing sense of the terns as showing that where care was taken to keep the captured birds in good condition before they were released, they could find their way back to the nesting colony over almost any distance up to a thousand miles, and this although the region of the return journey over the Gulf of Mexico presented no landmark to serve as a guide. It has been pointed out that the ability of these untrained birds to find their way home over a thousand miles through haze, storm and darkness, and over an unknown sea, is all the more remarkable when it is compared with the record long-distance flight of a homing pigeon, 1010 miles; for pigeons are selected and go through an intensive training to accustom them to the landmarks of the region they must traverse on their return journey.

Mayflies and Man

The disappearance of mayflies (*Ephemera* spp.) from many parts of England where formerly they appeared in vast numbers is well known. How far this is due, indirectly, to human agency is not yet clear, but it is likely that operations leading to rapid drainage of adjoining country with consequent flushing of watercourses are among the factors involved. A current too fast to allow of an adequate deposit of fine sand, 0·25 mm.–0·05 mm., markedly affects the normal development of eggs of *Ephemera danica* (Percival and Whitehead, 1926). Moreover, ephemerid nymphs in general need a substratum of a well-defined sort composed of particles 1 mm.–0·25 mm. in diameter in order to thrive. Such a bottom is easily disturbed by sudden rushes of flood water.

The influence of man both by land clearance and by the introduction of new species among the native fauna has been found to have very marked results on the New Zealand Ephemeroptera. Bush felling near watercourses has altered the conditions in streams so that in summer the beds dry up and nymphs and egg masses shrivel. The great increase in rapidity of the run-off from cleared land after freshets results in maimed insects pounded by current-borne stones and debris. Removal by felling of shelter for subimagines and imagines leaves them an easy prey to birds like the pied fantail, the ground lark and the introduced chaffinch. Of the food of the introduced trout, 9 per cent consists of various Ephemeroptera in the Wellington district. Between two and three hundred nymphs of *Coloburiscus humeralis* were found in the stomach of an Atlantic salmon—another introduced fish—from the Waiau River (Phillips, 1931).

A converse case has been noticed in the Yorkshire Nidd, a rapid stream where, owing to the impounding of water in reservoirs higher up the river, flooding has been very much reduced. In consequence, a certain amount of fine deposit occurs among the larger stones, affording shelter to many nymphs of *E. danica* (4 per 4 sq. dec.), a number sufficient to produce a considerable crop of adults annually (Percival and Whitehead).

Societies and Academies

LONDON

Physical Society, March 17. H. A. NANCARROW: A method for the determination of the thermal conductivities of rocks. The rock specimens are turned as circular cylinders of diameter 5 cm. and height 2 cm., and are bisected by a cut made perpendicular to the base along one diameter. The top of the cylinder is heated and the temperature-gradient in the specimen is measured by means of thermocouples held in a mica holder inserted in the cut. The temperature-distribution and heat flow in the specimen are each represented by a series containing Bessel and hyperbolic functions. Constants involved in the arguments of these functions are dependent upon the loss of heat from the hot surfaces exposed to the air in the apparatus. E. E. WRIGHT: A note on the Kerr cell. The distortion due to the curvature of the (light, voltage) characteristic of a Kerr cell is discussed, and an expression giving the amplitudes of the Fourier components of the light-variation due to a pure alternating potential applied to the cell is obtained. Sets of curves showing the variation of percentage of second and third harmonic with bias and with amplitude of the applied alternating potential are given. The working conditions for minimum distortion obtained from these curves agree with those used in practice. The late A. C. G. BEACH: An experiment bearing on Talbot's bands. The form of diffraction pattern observed in a spectroscope when a point of light is produced on the slit of the collimator, and an aperture in which the upper or lower half is covered with a retarding plate is between the collimator and telescope, is discussed and the bands so produced are used to explain Talbot's bands.

Society of Public Analysts, April 5. H. G. REES: Notes on the iron and copper in liver and liver extracts. The amounts of iron and copper previously recorded for the livers and liver extracts of various animals are too low; these metals are very incompletely extracted by water. In the author's experiments the proportion of iron was somewhat higher, whilst the copper was very much lower than the figures given by Meyer and Eggert. G. W. MONIER-WILLIAMS: Determination of the freezing-point of milk. The three main factors influencing the determination are: super-cooling; the water-value of the container, thermometer, bulb and stirrer; and the heat-exchange with the surrounding medium. With the new type of apparatus devised by the author, the supercooling correction can be determined with a fair degree of accuracy, the final temperature remains constant for several minutes, and excellent heat insulation is secured by the casing of compressed cork.

DUBLIN

Royal Irish Academy, Feb. 13. COMMON and CAIRNS: The colonisation of a disused millpond at Hillsborough, Co. Down. An account of observations made on the ecology of a disused millpond over a period of three years. The pond has become largely silted up during the past twenty years. The phases in the progressive colonisation of the pond are very clearly defined. The submerged phase, at first dominated by *Potamogeton*, is now dominated by *Chara*. The main emergent phase is an Equisetetum but this rôle is assumed at one place by *Caricetum* from which *Equisetetum* is absent. Invasion by *Carex* transforms the Equisetetum into sedge meadow: this is succeeded by *Salicetum*. The plant succession is regarded as a colonisation of a silt slope and not as a true hydrosere.

PARIS

Academy of Sciences, March 27 (*C.R.*, **196**, 881–972). EMILE BOREL: An elementary problem of probabilities and the quasi periodicity of certain arithmetical phenomena. R. FOSSE, P. DE GRAEVE and P. E. THOMAS: The rôle of allantoic acid in the higher plants. Summary of the methods of identification and determination of allantoic acid in plants. Also a study of the changes in the proportions of this acid during germination. J. DELSARTE: On a ds^2 with non-static axial symmetry and some connected problems. GEORGES BOURION: A class of Taylor's series. JULIUS WOLFF: The extension of a theorem of Warschawski on conformal representation. MICHEL LUNTZ and PAUL SCHWARZ: A particular case of the movement set up in a viscous fluid by the rotation of a cylinder. FLORIN VASILESCO: Movement with a wake, in three dimensions, of a solid body in a fluid. R. D'ADHÉMAR: The equations of the gyroscopic movement of stable projectiles. JEAN MARIANI: Quantic mechanics and the theory of finite and continuous groups of Sophus Lie. G. LEMAÎTRE: Spherical condensations in an expanding universe. E. HOCHARD: Maintained oscillations. Some applications of a photoelectric cell for producing maintained electrical oscillations of determined period. E. GAMBETTA: The measurement of small luminous fluxes by means of the photoelectric cell. HENRI ABRAHAM: The definition of the magnetic field. A comparison of the modes of calculation of Maxwell and of J. J. Thomson: the latter is easier in its practical applications. P. LAINÉ: The magnetic properties of liquid ozone. Magnetic measurements on ozonised oxygen having given discordant results, experiments with liquid ozone are now described. From the results of these it is deduced that ozone is paramagnetic and has a susceptibility independent of the temperature. CH. BERTIN: The accuracy attainable in radiogoniometry and the use of the *droite-radio*. F. CROZE: The aberrations of coma of light pencils of large inclination. NY TSI-ZE and CHOONG SHIN-PIAW: The absorption of light by ozone between the wave-lengths 3050 A. and 2150 A. A table of coefficients of absorption for 194 wave-lengths. PARISELLE: A curious case of change of sign of the rotatory power and of mutarotation. A study of the properties of the complex compound obtained by dissolving aluminium hydroxide in tartaric acid. P. JACQUET: The adsorption of colloids by metallic surfaces and its influence on the adherence of electrolytic deposits. The colloids studied fall into two groups, those clearly affecting the adherence of the deposit, such as proteins and peptones, and those without action, such as gums and dextrin. MAURICE CURIE and S. TAKVORIAN: The radioactivity of a neodymium-samarium fractionation. The element 61. Starting with a mixture of 5 kilograms of neodymium and samarium (from Indian monazite) the authors find that neodymium and lanthanum show no radioactivity. Samarium emits a very absorbable radiation, apparently not due to element 61, but the intermediate fractions give a more penetrating radiation probably due to element 61. A. GIRARD and G. CHAUDRON: Crystalline systems of microcrystallised ferric oxides. Results of X-ray analysis and thermomagnetic analysis of ferric oxide prepared by eight methods. P. MONTAGNE: The graphical resolution of problems of homogeneous chemical equilibrium between three constituents. G. CHAMPETIER: The action of solutions of orthophosphoric acid on ordinary cellulose. The existence of the addition compound $3C_6H_{10}O_5.H_3PO_4$ is proved by Schreinemakers' method: washing with water regenerates cellulose without mercerisation. E. CARRIÈRE and R. LIAUTÉ: The estimation of sulphurous acid and alkaline sulphites by potassium permanganate. A. SANFOURCHE: The relations between the properties and constitution of tricalcium phosphate. MME. G. ALLARD: The refractometric determination of organic acids. MLLES. H. VAN RISSEGHEM and B. GREDY and M. L. PIAUX: The ethylene linkage. Study of some linear or branched hexenes. Raman spectra of eight hexenes. V. KUNZL and J. KÖPPEL: A precision method for measuring the constants of crystalline networks. PAUL GAUBERT: The influence of foreign substances in the state of solid solution on the domain of stability of crystals. J. BARTHOUX: The Siwilak and the recent volcanic rocks in Afghanistan. ANDRÉ LENOBLE: The schisto-quartzo-limestone series in the centre of Madagascar. F. BLONDEL: The distribution of the richness of metalliferous deposits. L. TUWIM: First results obtained in a new cosmic ray observatory. J. CHAZE: The presence of anthocyanin pigments or oxyflavone compounds in the aleurone grains of certain Gramineæ. MARC SIMONET: The behaviour of the chromosomes in some complex hybrids of *Iris*. MLLE. PANCA EFTIMIU: The presence of a fungus in *Bucegia Romanica*. RAYMOND-HAMET: Digitalin compounds do not prevent cardiac syncope produced by adrenaline when it is made to act during the stimulation of the vagus. MME. HUFNAGEL and MARCEL JOLY: The different behaviour with regard to X-rays of the fly and butterfly in the course of their metamorphosis. FRED VLÈS, MLLES. ANNA GROSSMANN and MADELEINE GEX: The electromotive forces developed by man in contact with a metallic conductor. JEAN CAMINOPETROS and B. CONTOS: The intradermal reaction with pustular fever. CHARLES LAPP: The rotatory power of quinine salts in aqueous solution. If the pH is brought to about 5·5 with chlorophenol red as indicator, quinine can be determined optically whatever may be the acid with which it is combined.

MELBOURNE

Royal Society of Victoria, Dec. 8. R. T. PATTON: Ecological studies in Victoria. (1) The Cheltenham flora. The association is closely allied to the heaths of the northern hemisphere, both ecologically and taxonomically, a constituent family being Epacridaceæ. The composition of the association is very rich, consisting of members of many diverse families. All, however, possess an ericoid type of leaf. The physiognomy is related to both the climatic and the soil conditions. The soil is very sandy and belongs to the podsol type but it exists under climatic conditions widely different from those of the podsol areas of Europe. The association is typically xerophytic but the morphology of the ericoid leaves does not show any consistent adaptation to the dry period of the year. E. BROADHURST and J. D. CAMPBELL: The geology and petrology of the Mount Leinster district, north-east Victoria. The oldest rocks are Upper Ordovician sediments which have been converted to schists and quartzites by an intrusion of granodiorite, which itself becomes gneissic at its border. A granite porphyry is intruded into the granodiorite. A younger series of alkaline rocks consist of trachytes and trachyte tuffs, into which a soda syenite has been intruded. At the contact with the syenite, the biotite in granodiorite has inverted to hornblende and finally to augite, and quartz has been dissolved and orthoclase has been deposited in its place. A fault on Mount Leinster has brought the granodiorite and trachyte into contact, and a series of specimens across the shear zone, showing granulation, is described. The felspars in the syenite, particularly in some of the dykes, have a peculiar interpenetrating structure. FREDERICK CHAPMAN: Some Palæozoic fossils from Victoria. The following are described and figured: A species of Silurian seaweed, *Bythotrephis divaricata*, first described from the Wenlock of England, and occurring near Walhalla and at Studley Park; two new species of foraminifera from the Silurian of Lilydale and Mitcham, *Hemigordius lilydalensis* and *Trochammina bursaria*, both of which genera have hitherto been unknown from rocks older than the Carboniferous; and a new species of brachiopod, *Orbiculoidea antipodum* from the Lower Ordovician of Lancefield (Darriwilian Series), related to *O. perrugata* from the Caradoc beds of Ireland, described by McCoy in 1846.

VIENNA

Academy of Sciences, Jan. 12. JOSEF SCHAFFER: Differences in the tissue structure of homologous organs (prepuce glands) in mice and rats. In arrangement and external form these glands, although of different size, are very similar in the two animals. As regards fine structure and type of secretion, however, such marked differences appear that the glands must be regarded as of quite different types. In the rat, the secretion is mainly albuminous, and in the mouse purely fatty in character. KARL MAYR: Definite integrals with Bessel's functions. The investigations begun in the author's "Bestimmte Integrale und hypergeometrische Functionen" are continued and applied to the generalisation of an integral examined by Struve and Rayleigh. KARL KLEMENZ: Investigations on Archimedean bodies in spaces of several dimensions. It was found earlier that, in space of four dimensions, only two of these bodies are possible, when congruence of the angles and equality of the edges are required. Extension of the investigations to spaces of more than four dimensions shows that, in such spaces, polytopes with congruent angles and equal edges no longer exist. FRIEDA KANN: Influence of temperature on the stages of growth of *Dixippus* (*Carausius*) *morosus* Br. et Redt. ROMAN J. WOJTUSIAK: Antagonistic action of ultra-violet rays on the phototaxy of *Daphnia magna* Straus. Like blue and violet light, light rich in ultra-violet rays repels daphnids; like darkness, light poor in ultra-violet rays exerts no action, and like red and yellow light, white light free from ultra-violet components has an attracting effect. TOSHIHIKO YAMANÔUTI: Growth measurements on *Sphodromantis bioculata* Burm. (5) Determination of the absolute increases in the size and number of the facets. HANS HORNICH. (1) Construction of integrals of the first genus on special transcendent Riemann surfaces.

Jan. 19. **Martin Kofler**: Distribution of precipitations according to their diurnal periods. **Friedrich Hernegger**: Sensitive methods for the detection of uranium in spring waters and deposits. For determining the traces of uranium present in radium-containing springs, the chemical method with potassium ferrocyanide and methods based on fluorescence have been investigated. **Josef Hoffmann**: Alkali- and barium-silver chlorides. Huantajayite and similar sodium-silver chlorides artificially prepared remain unchanged in sunlight, but if the content of silver chloride is increased, the compounds become sensitive to light. The coloration of huantajayite under radium irradiation is similar to that of natural rock-salt, but the irradiated pressed mineral exhibits no colour changes. The colours of potassium-, barium-, and cæsium-silver chlorides are considered. **Rudolf Toth**: Geology of the "Schneeberg" region. **Viktor Pietschmann**: Three new fish species (Cyprinides) from Asia Minor. These species are: *Acanthorutilus handlirschi* nov. spec., *Varicorhinus pestai* nov. spec., and *Schizothorax prophylax* nov. spec.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 15

Royal Geographical Society, at 8.30.—Prof. Giotto Dainelli (and others): "The Geographical Work of H.R.H. the Late Duke of the Abruzzi".

Tuesday, May 16

British Science Guild, at 4.30—(Research and Development Lecture in the Carpenters' Hall, Throgmorton Avenue, E.C.2.)—Sir Harold Carpenter: "Metals in the Service of Human Life and Industry".

Royal Photographic Society.—Dr. G. M. B. Dobson: "The Significance of Ozone in the Atmosphere and its Measurement by Photographic and Photoelectric Methods".

Wednesday, May 17

London School of Hygiene and Tropical Medicine, at 3.15.—Dr. R. H. Crowley: "Child Guidance".*

Royal Society of Arts, at 4.30.—Prof. Maiuri (director of excavations at Pompeii and Herculaneum): "The Recent Excavations of Herculaneum and Pompeii".

Folk-Lore Society, at 8—(at University College, Gower Street, W.C.1.)—Sir Reginald F. Johnston: "Tree Worship and Holy Wells in China".

Friday, May 19

Royal Society of Arts, at 4.30.—Sir Arnold T. Wilson: "The Suez and the Panama Canals—a Comparison".

Bedson Club, at 6.30—(in the Chemistry Theatre, Armstrong College, Newcastle-upon-Tyne).—Prof. A. Harden: "The Chemistry of Fermentation".

Royal Institution, at 9.—Dr. V. M. Slipher: "Planet Studies at the Lowell Observatory".

Third Glass Convention, May 18–20. To be held at Buxton.

Official Publications Received

GREAT BRITAIN AND IRELAND

Ancient Monuments of Great Britain. List of Monuments prepared by the Commissioners of Works (to December 31, 1932). Pp. 72. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

The Journal of the Royal Agricultural Society of England. Vol. 93. Pp. 7+388+clxx+xii+12. (London: John Murray.) 15*s*.

Science and the Community. By Dr. Alexander Findlay. Pp. 18. (London: Institute of Chemistry.)

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1932 presented to the Annual Meeting, February 13. 1933. Pp. 44+31. (York.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 72, No. 436, April. Pp. 269–364+xvi. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

The Board of Greenkeeping Research. Report for 1932. Pp. 32. The Journal of the Board of Greenkeeping Research. Vol. 3, No. 8. Pp. viii+56+xxxv+8 plates. 2*s*. 6*d*. (Bingley: St. Ives Research Station.)

Modern Technology: a Select List of Recent Books available at the Coventry Public Libraries. Pp. 16. (Coventry.)

Department of Health for Scotland. Third Report of the Scottish Advisory Committee on Rivers Pollution Prevention. Rivers Leven and Ore (Fife). Pp. 46. (Edinburgh and London: H.M. Stationery Office.) 9*d*. net.

Reports of the Council and Auditors of the Zoological Society of London for the Year 1932, prepared for the Annual General Meeting to be held on Friday, April 28, 1933. Pp. 99. (London.)

The Buckland Foundation (1926). The Buckland Lectures, First Series for 1929. i. Frank Buckland's Life and Work; ii. Fish Farming—Old and New; iii. The Balance of Life in the Sea. By Prof. W. Garstang. Pp. 46. (Aberdeen: The *Fishing News*.) 6*d*.

Economic Advisory Council: Committee on Locust Control. The Locust Outbreak in Africa and Western Asia, 1925–31. Survey prepared by B. P. Uvarov. Pp. 87+13 maps. (London: H.M. Stationery Office.) 5*s*. net.

Fumifugium: or the Inconvenience of the Aer and Smoake of London Dissipated. By John Evelyn. First published in 1661 and reprinted with an Introduction by Rose Macaulay. Pp. 42. (Manchester: National Smoke Abatement Society.) 6*d*. net.

Science Library. Bibliographical Series, No. 82: Plastics. Pp. 104. (London: Science Museum.) 5*s*.

OTHER COUNTRIES

Reale Accademia d'Italia. Fondazione Alessandro Volta. Viaggi di Studio et Esplorazioni, 1: Viaggi di Studio ed Explorazioni. Pp. 78. (Roma: Reale Accademia d'Italia.) 8 lire.

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 16: October, November, December, 1932. By Ernest A. Hodgson. Pp. 265–286. (Ottawa: F. A. Acland.) 25 cents.

Transactions of the San Diego Society of Natural History. Vol. 7, No. 19: A Pleistocene Record of the Flammeolated Screech Owl. By Loye Miller. Pp. 209–210. Vol. 7, No. 20: Granitic Domes of the Mohave Desert, California. By William Morris Davis. Pp. 211–258+plates 12–15. Vol. 7, No. 21: Notes on the Foraminifera of the Type merced at Seven Mile Beach, San Mateo County, California. By Roscoe E. and Katherine C. Stewart. Pp. 259–272+plates 16–17. Vol. 7, No. 22: A New Species of Echinoid from Ramaulipas, Mexico, by Merle C. Israelsky; and A New Gryphæoid Oyster from the Eocene of California, by Leo George Hertlein. Pp. 273–282+plate 18. Vol. 7, No. 23: A Northern Race of Melozone Rubricatum (Cabanis). By A. J. van Rossem. Pp. 283–284. (San Diego, Calif.)

Iowa Geological Survey. Vol. 35: Annual Report, 1929; with accompanying Papers. Pp. 548. (Des Moines, Iowa.)

Cornell University: Agricultural Experiment Station. Memoir 142: Wholesale Prices for 213 Years, 1720 to 1932. Part 1: Wholesale Prices in the United States for 135 Years, 1797 to 1932, by G. F. Warren and F. A. Pearson; Part 2: Wholesale Prices at New York City, 1720 to 1800, by Herman M. Stoker. Pp. 222. (Ithaca, N.Y.)

Proceedings of the United States National Museum. Vol. 82, Art. 7: A Fossil Rhinocerous (*Diceratherium armatum* Marsh) from Gallatin County, Montana. (No. 2948.) Pp. 4+3 plates. (Washington, D.C.: Government Printing Office.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 29, Part 5: The Phytogeography of the Middle Kuriles. By Misao Tatewaki. Pp. 191–363+7 plates. (Tokyo: Maruzen Co., Ltd.)

Brooklyn Botanic Garden Record. Vol. 22, No. 2: Twenty-second Annual Report of the Brooklyn Botanic Garden, 1932. Pp. 165. (Brooklyn, N.Y.)

Smithsonian Miscellaneous Collections. Vol. 89, No. 5: Forecasts of Solar Variation. By C. G. Abbot. (Roebling Fund.) (Publication 3214.) Pp. 5. (Washington, D.C.: Smithsonian Institution.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University, No. 94: On the Moment of the Force acting on a Flat Plate placed in a Stream between two Parallel Walls. By Susumu Tomotika. Pp. 357–393. 40 sen. No. 95: A Speedometer which Indicates True Air-speeds. By Tatudirô Sasaki and Tokurô Yoshida. Pp. 395–415. 30 sen. (Tôkyô: Koseikai Publishing House.)

Geological Survey Department, Tanganyika Territory. Short Paper No. 11: The Eastern Extension of the Lupa Goldfield (Ipogolo, Sengambi, Shoga). By Dr. D. R. Grantham. Pp. ii+9. (Dar es Salaam: Government Printer.) 1*s*.

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 12, No. 9: New Species of Fish from the West Indies. By William Beebo and Gloria Hollister. Pp. 83–88. (New York City.)

Smithsonian Institution: Freer Gallery of Art. Oriental Studies No. 1: The Story of Kâlaka; Texts, History, Legends and Miniature Paintings of the Śvetāmbara Jain Hagiographical Work. By Prof. W. Norman Brown. (Publication 3187.) Pp. viii+149+15 plates. (Washington, D.C.: Smithsonian Institution.)

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Research in Central Asia

HOWEVER admirable in theory may be the ideal that science should transcend the limitations of nationality, it has to be recognised that there are fields of scientific research in which, in the circumstances of the present day, this is neither possible nor perhaps in every way desirable. The intensity of national self-consciousness, which has been fostered by various influences during the last fourteen or fifteen years, has invaded the field of science, and restricts the activities of research in those branches of study which depend for their material on the exploration, or as the nationalists would have it, the exploitation, of territory to which everywhere access is limited by national rights. Further, as a logical consequence, each nation claims, not necessarily without some show of justice, to determine the number and character of the specimens collected which shall be allowed to leave the country or shall be retained to enrich the national collections.

This intensification of national feeling is responsible for the increased stringency of regulations which once were at worst irksome, but now, at times, have become definitely obstructive or even prohibitive. The most recent and serious example of a more exigent regulation of scientific exploration—especially serious because of the wide range of scientific activities affected—is afforded by China. The strongly restrictive attitude of the Chinese authorities since 1928 towards scientific expeditions working within the boundaries of the Empire has imposed conditions upon the work of the Central Asiatic expedition of the American Museum of Natural History, which the Museum does not feel able to accept, and has brought to an end ten years of unprecedented contribution to scientific knowledge; and it has caused Sir Aurel Stein to withdraw from Turkistan, where his explorations had brought to light an unexpected wealth of evidence bearing upon the cultural history and geography of Central Asia.

It may be a not unreasonable view that the very success of these expeditions has led to their embarrassment. Dinosaur's eggs, for which collectors, according to the story given a world-wide circulation in the Press, were prepared to pay £100 each, six thousand manuscripts of early Buddhist and other writings, including texts translated by the Chinese Buddhist missionary and traveller of the seventh century, Hsüan-Tsang, and priceless painted silks, the earliest known, with many other finds of equal scientific, if less widely advertised, value when conveyed to America and England, may well have impressed upon the Chinese the idea that they were being deprived of historic treasures of untold worth. With this point of view, the European peoples, who are making every effort to prevent their own artistic and historic treasures from leaving their respective countries, may well sympathise. From the scientific point of view, it is possible to hold that a specimen, whether appertaining to the natural kingdom or to the culture of man, is best preserved for study within striking distance of its natural environment, provided that it is then reasonably accessible to students and that adequate facilities are afforded for its examination.

While the claims of science and politics are thus seen to coincide in the demands of regional studies and historic association, too great insistence upon them may prove detrimental to the advancement of knowledge. It may check exploration. Expeditions on the scale now considered necessary for regional exploration in an area like Central Asia are expensive undertakings, and can be initiated and carried out only by, or through, a great organisation, such, for example, as one of the more important museums. Apart from finance, only an organisation such as this can hope to bring together and hold the numerous body of experts in the various branches of science—geology, geography, climatology, zoology, botany, palæontology, anthropology and archæology—which is considered essential if full advantage is to be taken of the opportunity afforded by such an expedition for joint study of related problems in the field. It is not unnatural, however, that in the conduct of an expedition on this scale the organising body should expect to be allowed a certain freedom of initiative to enable it to deal with unexpected developments in the course of the investigation, as new vistas are opened up by exploration ; and that it should look for a return in the shape of additions to its collections. If in both these directions the regulations laid down by the national authorities are unduly restrictive, exploration presents no adequate inducement and science is deprived of material *ex hypothesi* essential to its advancement.

Much of this may seem obvious. Its recapitulation will serve to recall conditions which have been found obstructive to research in more countries than one. In China they have brought about a deadlock in the two instances mentioned, notwithstanding the expressed desire of the Chinese to co-operate in scientific exploration. In view of the importance of China as a future field of research, it is of the utmost moment that every effort should be made to bring about a more favourable situation in order to enable science to reap the fullest advantage from Chinese readiness to join in promoting the exploration of the vast store of scientific material in that Empire.

China is the gateway of Central Asiatic research. Not only does the vast area of Chinese Turkistan and Inner Mongolia lie under her jurisdiction ; but also through China access may be gained to Outer Mongolia, Russian Turkistan, and Tibet along ways which have been trodden by one race after another for thousands of years. The achievement of the American Central Asiatic expedition in Mongolia in geology, in palæontology, in palæobotany and, to a lesser degree, in archæology has demonstrated the importance of that area as a great and almost unexplored source of evidence for the history of the Asiatic continent and as a centre of dispersal of many forms of animal life. The sense of this importance is borne upon us, not so much by the evidence that has been collected during the past ten years, great as this is in the mass, as by the array of further problems in the various sciences which that evidence has suggested, but of which the investigation is now suspended. It may well be, as one of the members of the expedition hopes, that eventually further exploration in this area will bring to light evidence of *Proanthropus*, the precursor of man, for whom research has waited so long. The results of Sven Hedin's expedition in Chinese Turkistan during the last six years, an expedition planned on similarly comprehensive lines to those of the American expedition to Mongolia, also point to the importance for scientific research of this area.

The material which has already been obtained, and which it is hoped to obtain from further exploration, is not merely of interest for its bearing on strictly local problems, or even of problems within the bounds of Asia. In Mongolia, for example, the alternation of desiccation with the growth of vegetation, for which there is geological evidence, and in later ages the variations in the occupation by man of areas now desert, may well help to solve, by the light they throw on climatic oscillation, problems relating to early man in East Africa and the relation of conditions in both Africa and Central Asia to the glaciations and associated cultural material of

Europe. Again, studies in the palæobotany of Mongolia are already throwing light on the distribution of the flora in tertiary times not only of the extreme east of Asia, but also of America.

Such problems as these are of world-wide interest, and should be attacked in no particularist spirit. Central Asia, indeed, has attracted scientific exploration from many sources. Within the present century, Russian, American, German, French, Italian, Swedish and British expeditions have contributed to the study of its problems in geography, geology, palæontology, zoology, archæology and other related sciences. Japan is interested in these researches in view of their bearing on her own problems. Nor must it be forgotten that the palæontological researches of the Geological Survey of China, which led to the first discovery of evidence of Peking man *in situ*, were initiated by Swedish money and with a Swedish personnel. Since 1928, China herself has had a body, now known as the Commission for the Preservation of Ancient Objects, which concerns itself with the scientific exploration of the Empire's natural and cultural history. Although it has not undertaken scientific exploration independently, it has taken steps to ensure that Chinese investigators should be included in the personnel of foreign expeditions which have received the sanction of the Chinese authorities.

In view of the magnitude of the undertaking, the importance to science of the results, and of past history, the exploration of Central Asia—and with this must be included a great part of China proper—seems pre-eminently a matter for international co-operation. On political and other grounds, it is clear that the task is too great for China unaided, at any rate for the moment; while co-operation between China and individual expeditions conducted by foreigners may not, at the best, be entirely satisfactory, failing any international board of arbitration in scientific matters, such as might perhaps have been in other circumstances a function of the International Committee on Intellectual Co-operation.

Of the various possible methods of dealing with the situation, the most practicable is, perhaps, an International Institute for Central Asiatic research. Such a proposal, indeed, has been put forward by Dr. Roy Chapman Andrews, leader of the American expedition to Mongolia, in the recently published first volume of the final reports of the Expedition. Dr. Andrews, however, has now abandoned this proposal in view of the differences which have arisen with the Chinese authorities and have brought his explorations to a close.

There is no reason why this should be final. Whereas, however, Dr. Andrews intended that the headquarters of the institute should be in New York, with field headquarters in Peking, it is probable that, if the full co-operation of the Chinese is to be secured, the Institute should be situated in China. Each of the western nations participating in the work of the Institute should have a resident representative, advised and supported by a committee in his own country, acting as a medium of communication between the general body of scientific workers of that country and the Institute, as well as being responsible for finance. The countries territorially interested, China, Mongolia, the Russian Soviets and Tibet, would also be represented in the Institute, although the extent to which they should participate in its actual work would, perhaps, be difficult to suggest before the proposal begins to take more definite shape. Full co-operation would seem the ideal, but might be difficult of arrangement. Such an Institute should be in a position to formulate and organise schemes of research upon a settled plan, with economy of money and effort and, it is hoped, with an absence of friction, whether relating to the objects and details of exploration, or the disposal of its material results to the best advantage of scientific studies.

Science and Culture

The Anatomy of Modern Science: an Introduction to the Scientific Philosophy of To-day. By Bernhard Bavink. Translated from the fourth German edition, with Additional Notes and Bibliography for English Readers, by H. Stafford Hatfield. Pp. xiii+683. (London: G. Bell and Sons, Ltd., 1932.) 21*s.* net.

THE imperative need of supplementing the specialist's knowledge by a more comprehensive consideration of the problems of science, without which the former is little more than a kind of scientific trade, is increasingly felt and is illustrated by the number of books which in recent years have attempted to interpret to a wide public the results of scientific research, and to correlate from a general and philosophical point of view the significance of these results and of the problems still unsolved. Such an exposition calls for exceptional gifts, and though the attempt has been freely made in England, there still appears to be an outstanding need for a real synthesis on broad philosophical lines of the inexhaustible material of natural science.

The outstanding success of Bavink's "Anatomy of Modern Science" in Germany may be attributed to his presentation in the first place of the results of science out of which the philosophical questions have been allowed to develop naturally, and few books have raised more fairly the problems of the relations of science and philosophy or given a more sincere, impartial or patient interpretation of human values. If only for its brief remarks on the problems of rationalisation and the mechanisation of life, the book should be welcomed by all who, from the scientific side, are attempting to see life steadily and to see it whole.

A grave danger of the present time is that man's knowledge of physical laws far exceeds his knowledge of the science of man. On this point Bavink cites some impressive evidence. A convinced believer that the biological sciences are capable of yielding genuine knowledge, he emphasises the importance of scientific biological knowledge for the discussion of cultural questions. He regards the neglect of science in the curricula of our higher educational institutions as responsible for the inadequate conceptions of the driving forces of history possessed by large sections of educated people. Those who confuse culture with literature and art cannot understand the biological conditioning of cultural achievement, and accordingly cannot draw the appropriate deductions.

Ignorance of the true causes of such processes results in our failure to perceive that many so-called social reforms are in fact anti-social, and, apart from perpetuating tainted and undesirable elements in our population, lead to opposition to the measures required to preserve racial health. This misdirection of moral and social effort is a serious factor in our present position, above all in the framework of democracy, and the danger of persistent degeneracy is too serious to be ignored. Bavink makes the trenchant comment that no civilisation has ever possessed the knowledge which we possess of the deeper causes of cultural processes and racial decline. The remarkable development of our physical technology gives us some idea of the possibilities in biotechnology when biology represents a science as advanced as physics or chemistry.

Here we touch on the ideal of fitness for a purpose for its own sake, an ideal which is behind the present-day urge for rationalisation and scientific administration, and in one of the most suggestive chapters of his book Bavink discusses the value of technology as a cultural field for itself, standing on an equality with art, science and religious ethics. This discussion is the more timely in view of the tendency to overstress the financial side in referring to the economy of technology.

In his presentation of these issues, Bavink brings us face to face with the problem of values. These concluding chapters are undoubtedly provocative, but they keep clearly in mind the question of preserving the values bequeathed to us by the past without exposing civilisation to unbearable hindrances. There is no hasty dogmatism but the realisation, taught by the historical perspective, that it is fundamentally wrong to believe we hold in our hands the absolute and final truth, the ultimate value in any category. As in the field of scientific knowledge of truth, there must be constant striving for truth, believing that such striving is not in vain, that æsthetic values, like scientific truths, have a significance independent of whether, where, and by whom they are grasped. Scientific workers and artists of the highest rank have often shared the same feeling that what was given to them to achieve was something that they laid hold of, and not really something they themselves produced.

Bavink concludes his exposition of scientific philosophy upon a note which irresistibly recalls General Smuts's presidential address in 1931 to the British Association. "Where the scientist and philosopher have to be silent, the artist, the poet and the prophet may still speak to us, indeed, this is their truest realm. What can no longer be stated in the ingenious phrases of human wisdom may still be brought home to the sensitive spirit by the language of religious inspiration, art, and above all music to such an extent that we may well be in doubt which may bring us nearest to the root of the matter."

It is a worthy close to a valuable work which gives us at once a comprehensive view of man's achievements in the physical world, as welcome for its pragmation and relation to the real problems of our society as for its consciousness of the spiritual and moral values among which science itself is rightly to be ranked.

R. B.

Stands Darwin Where He Did?

The Causes of Evolution. By Prof. J. B. S. Haldane. Pp. vii+235. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 7*s.* 6*d.* net.

ONCE again Prof. J. B. S. Haldane has produced a lively and stimulating book. Dealing with problems of general significance, it contains much to interest both the professional biologist and the layman. It is based on a course of lectures delivered at the Prifysgol Cymru, Aberystwyth, and entitled "A Re-examination of Darwinism". Although, as its new title implies, its scope is now somewhat larger than the original title of the lectures would suggest, yet the main purpose of the book is to examine the Darwinian hypothesis of natural selection as a cause of evolution in the light of modern experimental and theoretical work.

As we should expect, Prof. Haldane's discussion combines vigour with authority, and his text is full of new and illuminating material. His first chapter states the problem. He shows how, when the doctrine of evolution first gained general acceptance, it was combined, as Darwinism, with the explanatory idea of natural selection. Later the two became dissociated. Positive evidence for evolution accumulated and became more and more convincing. But at the same time the belief in natural selection, which was originally almost inseparable from the belief in evolution, has weakened—or at least, it has not gained support at anything like the same rate, so that, as Prof. Haldane writes, "a few biologists and many laymen regard it as more or less exploded". The reasons for this reaction are described.

The next two chapters, perhaps the most valuable in the book, deal with variation within a species, and with interspecific differences, in the light of recent genetical and cytological investigations. It is shown that

> "Interspecific differences are of the same nature as intervarietal. But the latter are generally due to a few genes with relatively large effects, and rarely to differences involving whole chromosomes or large parts of them. The reverse is true of differences between species. The number of genes involved is often great, and cytologically observable differences common. It is largely these latter which are the causes of interspecific sterility."

After this comes a discussion, occupying two chapters, of the effects of selection. The first part describes cases of stable populations, which have maintained the same numerical proportion between individuals of different types for long periods of time, and changing populations in which one type, owing apparently to environmental change and consequent selection, has increased rapidly at the expense of another. Then, natural selection having been shown to be an observable reality, and the different kinds of inheritable variations having been defined, there follows an inquiry into the extent to which the observable facts of evolution can be accounted for by supposing the one to be acting on the other.

Much of this discussion is based upon the recently developed mathematical theory of natural selection, a theory to which Prof. Haldane has made important contributions, and which he outlines in an appendix of forty-five closely printed pages. This is a most useful addition to the book, for many of the original papers are rather inaccessibly published.

Although Prof. Haldane inquires chiefly into the effectiveness or otherwise of natural selection as a cause of evolution, he comments briefly on other suggested causes, and makes damaging attacks from time to time against the Lamarckian position. The conclusion is that

> "it would seem that natural selection is the main cause of evolutionary change in species as a whole. . . . Although we have found reason to differ from Darwin on many points, it appears that he was commonly right when he thought for himself, but often wrong when he took the prevailing views of his time—on heredity, for example—for granted."

Finally, less scientific perhaps than the rest but excellent reading, there comes a chapter on the æsthetic aspects of evolution, in which the author, who has already told us why he believes in evolution, goes on to confess why he is glad that he believes as he does.

When Prof. Haldane concerns himself with present-day phenomena he is vividly interesting, but the reviewer was aware of a faint feeling of dissatisfaction when he came to the passages which extrapolate from present-day experience into the past. The trouble—which is due to a fault, not of the author but of the material at his disposal—arises from the following considerations.

Prof. Haldane deals of course in his discussion with the objection, which has so often been raised against Darwinism, that although natural selection accounts for the acquisition by an evolving race of advantageous characters, it cannot account for characters which are damaging, or which are simply indifferent. Palæontology gives examples of the evolution of characters which appear to be a hindrance rather than an advantage to their possessors, and systematists distinguish many species by differences of colour and shape which have no discernible survival value. To meet this criticism, Prof. Haldane points out, as Darwin did, but with a wealth of new examples, that characters which seem different are often linked together in inheritance and transmitted as a single unit. Thus various anatomically distinct strains of wheat differ also in their susceptibility to rust; the white and coloured populations of America die from different diseases; and there is evidence that immunity to measles is correlated with hair and eye colour. One can therefore account for the evolution of useless characters by supposing them to be accompanied by unknown advantages. Even a disadvantageous character might prevail if it was linked to a sufficiently profitable adaptation.

It will at once be seen that natural selection is a very formidable explainer of data. Indeed, short of abrupt discontinuity in the fossil record, it is difficult to imagine any facts that, properly manipulated, it would fail to explain. Imagine a fossil population consisting of individuals of two types—one, so far as we can judge from its structure, better adapted to the conditions than the other. If the well-adapted one is seen in the rocks to triumph and replace the other, well and good; if not, then one has only to postulate unknown characters linked to the visible ones to explain the issue. If *Eohippus*, instead of begetting and being replaced by the mechanically more efficient modern horse, had evolved out of it, the selectionist would only have to assume that the more toes a horse had the more immune it was against diseases.

The reviewer (who confesses that for the moment he has stopped reviewing) does not wish to suggest that the argument of linked characters is false. But it seems to him that by its aid the hypothesis that evolution occurred by natural selection acquires a facility that is almost indecent. Just as coffee can be too sweet, so a theory can explain too much—the first is undrinkable, the second is useless for scientific prediction. To be satisfyingly true, a theory should from time to time run the risk of disproof.

If we had a fossil record of Utopian completeness, how very different the state of affairs would be! Given a large collection of specimens of an evolving species all from the same level, one might perhaps determine from their sizes which individuals lived longest, and which died young. That would afford a basis from which the subsequent evolutionary history of the race could be predicted. But until that kind of check can be applied to it, the hypothesis that natural selection has been the main cause of evolution in the past is of a rather low order of truth. When it is applied to the horns of titanotheres or to the coilings and uncoilings of ammonites it is little more than specious. Our chief excuse for adopting it is that nobody can think of a better hypothesis—and that, after all, is a pretty poor one. Reinforced by the argument of linked characters, it can explain all the facts of evolution, but, skilfully handled, it could probably explain their converse equally well; and for that very reason it cannot at present be confirmed.

On the other hand, there is plenty of evidence in Prof. Haldane's pages that at least we are approaching a critical estimate of the importance of selection in such evolutions as occur to-day. There are the rapid advances in genetics and cytology and in the mathematical theory of selection; and there are the fascinating cases—all too few at the moment—in which a change in the composition of a population has been watched, one variety supplanting another. Here are opportunities for experiment and critical analysis, and promises of truths solid enough to satisfy even the most carping. The chapters in which the author gives an account of the present condition of this rapidly progressing branch of knowledge constitute by far the most exciting and valuable part of his book. G. P. W.

Universities Yearbook

The Yearbook of the Universities of the Empire, 1933. Edited by Sir H. Frank Heath. Published for the Universities Bureau of the British Empire. Pp. xxxi+975. (London: G. Bell and Sons, Ltd., 1933.) 15*s*. net.

IN issuing this admirable conspectus of British universities, the Universities Bureau, now in its twenty-first year, renders an important public service. The yearbook displays in convenient form authentic information regarding the personnel, organisation, regulations and recent activities of universities and thus obviates much laborious search among official calendars, many of which are to be found in but few public libraries. Facilitating, as it does, intercourse between seats of learning in all parts of the Empire, the yearbook becomes, as this intercourse develops, ever more indispensable. In addition to particulars given separately for each university there are generalised accounts of the universities of Great Britain and Ireland, of Canada, of Australia, of South Africa and of India, and these are from time to time rewritten: in the present issue the South Africa and India chapters have been revised and brought up to date, as those of Canada and Australia were in the two preceding issues.

In appendices covering two hundred pages are summaries of the conditions governing admission to various professions and careers for which university studies are a fitting preparation, the qualifications for admission to a first degree in the universities of Great Britain and Ireland, lists of open post-graduate scholarships, fellowships and grants for research available (whether within or without the Empire) to British nationals and lists of centres of scientific research and of scientific information (whether connected with the universities or not) with particulars of the conditions of admission of independent research workers.

In the present issue the presentation of the conditions of admission to the universities of Great Britain and Ireland and qualification for their first degrees has been further clarified—an improvement which will substantially enhance the value of the book in the estimation of the general public, as will also the further improvements that have been made in the general index. The memorandum and new articles of association of the Universities Bureau are published for the first time in the present issue together with the names of the representatives of the member universities. All the universities of Great Britain and Ireland are members, but of the remaining fifty-one universities in other parts of the Empire twenty are, it appears, not at present members of the Bureau.

Short Reviews

The Subject Index to Periodicals, 1931. Issued by the Library Association. Pp. x + 267. (London: The Library Association, 1932.) 70*s*.

THE Library Association is to be congratulated on having accelerated the rate of publication of the annual volume of its "Index to Periodicals", so that the volume for 1931 appears only eight months after that for 1930. For this promptitude we have to thank the editor, Mr. T. Rowland Powel, and the increasing number of voluntary contributors who help him in the work.

The present volume contains the titles of 25,650 articles selected from 582 periodicals. The periodicals examined are chiefly English and American. No less than 540 of these have been indexed. In addition, 23 French, Belgian and Swiss, 17 German and Dutch and two Italian periodicals have been examined.

It should be noted that, with few exceptions, no attempt has been made to index periodicals covered by the following publications: *Agricultural Index, Engineering Abstracts, Engineering Index, Index Medicus, Journal of the Society of Dyers and Colourists, Photographic Abstracts, Revue de Geologie*, Royal Meteorological Society's *Bibliography, Science Abstracts* and the Textile Institute's *Journal*. The subjects indexed are not confined to pure and applied science, for while poetry and fiction are excluded, the range of subjects dealt with is very wide. It includes, among other topics, art, architecture, music, language, literature, biography, education, law, medicine, labour questions, philosophy, peace and war.

The Changing Culture of an Indian Tribe. By Margaret Mead. (Columbia University Contributions to Anthropology, 15.) Pp. xiv + 313. (New York: Columbia University Press; London: Oxford University Press, 1932.) 28*s*. net.

DR. MARGARET MEAD's study of present conditions in an Indian tribe living on a reservation, of which the anonymity is preserved under the title of "Antler", deals more particularly with the position of the women. It is, in a sense, an experimental study in that it has been undertaken with a view of elaborating and testing methods of observation which, it is pointed out, will in the near future have to be employed in an increasing degree in ethnographical observation, owing to the rapid changes which are taking place all over the world among backward peoples, as they come more and more closely into contact with civilisation, and their customs and native economy are modified thereby. In a preface, Dr. Clark Wissler points out, for example, that the Indians whom Dr. Mead has had under observation, are living under two incompatible ideals. On one hand they are trying to preserve their old tribal ideals of community, and on the other hand they are forced to conduct their life in accordance with the white concept of competition. Dr. Mead's book, which has some valuable detail bearing on moral conditions among a partially detribalised people and on the modification of conditions in marriage, is thus of both special and general interest to the student of ethnology.

Pedigree Schedules: the Study and Preparation of Family Records. 11 pp. of Explanatory Notes, +30 Case Sheets and specimen Charts. (London: The Eugenics Society, 1932.) 10*s.*

THIS publication consists of a stout adjustable cover to which is attached a pamphlet of 11 pages of explanatory notes, a folded sheet of strong graph paper, destined to receive the pedigree chart, six blank leaves for comments on the pedigree, and thirty individual case sheets.

The explanatory notes are, up to p. 10, devoted to instructions for filling up the pedigree in standardised symbols and arrangements of generations. The greater difficulties of the individual case sheets are more lightly touched. Indeed the information asked for on these sheets is so slight as to be of little interest to the hypothetical descendants. Nationality and race are asked for, and the explanatory notes show that the latter question may be answered in such terms as ½ Slav, ½ Chinese. Spaces are left for the dates of birth and death, but marriage, perhaps on a modernist assumption that such a state is transient, fruitless, and of no interest to posterity, is not mentioned.

To be widely useful far more space should have been given to the occupational record and personal history of the subject, and space should not have been given for inquiries so vague as 'physical type'.

Land and Labour in China. By R. H. Tawney. Pp. 207. (London: George Allen and Unwin, Ltd., 1932.) 7*s.* 6*d.* net.

PROF. TAWNEY has written an excellent review of social, economic and educational conditions in modern China, taking the land and labour on the land as his starting point and the central core of the problem of future development. His book in part is based on his own observation and in part is an analysis of recent literature, of which a considerable proportion is by Chinese authorities. The special feature and chief source of interest in Prof. Tawney's work is its grasp of the Chinese attitude of mind towards Western civilisation and the recognition that in the final solution of the conflict of West and East now proceeding, in all probability it will be anything but a mechanical adoption of the machinery of progress, which in the long run will satisfy the Chinese temperament. As Prof. Tawney indicates, where we think in years or generations, the Chinese think in hundreds and thousands of years. Hence their tolerance of conditions which another people would feel to be unendurable, but also their faith in an ultimate solution.

The Frazer Lectures, 1922–1932. By divers Hands. Edited by Warren R. Dawson. Pp. xv+304. (London: Macmillan and Co., Ltd., 1932.) 15*s.* net.

THE Frazer Lectures, founded in honour of Sir James Frazer and to commemorate the completion of the third edition of "The Golden Bough", have now been delivered for ten years in succession in the Universities of Oxford, Cambridge, Glasgow and Liverpool in rotation. Among the lecturers have been the late Sidney Hartland, the late Canon J. Roscoe, Dr. A. Moret, Dr. A. C. Haddon, Dr. Marett, Prof. Westermarck, Prof. Malinowski, Sir Arthur Evans and Sir Arthur Keith. Although some of the lectures have already appeared in print, the convenience of having them together within the covers of this handsome and well-printed volume will appeal to all classes of reader, while marking the manner in which those representing different schools of thought have united to do Sir James Frazer honour.

The Races of Man: Differentiation and Dispersal of Man. By Prof. Robert Bennett Bean. (Highlights of Modern Knowledge.) Pp. vi+134. (New York: The University Society, Inc., 1932.) n.p.

DR. BEAN'S "The Races of Man" is a volume in a series published by an organisation in New York which exists for the popularisation of knowledge in science and art and now has offices in most of the more important countries of Spanish America. Dr. Bean's book is well produced and well and fully illustrated; but its text shows signs of over hasty preparation leading at times to statements perilously near misstatements. On such matters as racial differentiation and racial dispersal it is good and attacks its problems on broad lines; but in dealing with the origin and descent of man, the author does not appear to be abreast of either recent discovery or theory. Misprints are frequent.

Be your own Weather Prophet: a Book for the Holidays and After. By E. S. Player. Pp. vii+128. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1932.) 3*s.* 6*d.* net.

EVEN in these days of broadcasts, weather information is still profitable to the holiday maker, and this brightly written little book is full of weather wisdom. It sets out simply the relations of wind and weather to moving systems of isobars, and tells the reader how to diagnose the weather situation from his own observations, his only instruments being an aneroid barometer and a thermometer. The account of cloud prognostics is good, and the local peculiarities of weather are adequately discussed.

Climate and Acclimatization: some Notes and Observations. By Sir Aldo Castellani. Pp. viii+152. (London: John Bale, Sons and Danielsson, Ltd., 1931.) 7*s.* 6*d.* net.

SIR ALDO CASTELLANI describes with a wealth of technical detail the medical effects of tropical climates, especially of great heat and moisture and strong insolation. On the latter subject there is much to interest meteorologists, but in matters of meteorological theory the book is less satisfactory. There is an excellent bibliography.

Nature of Cosmic Rays*

By Prof. ARTHUR H. COMPTON, Ryerson Physical Laboratory, University of Chicago.

THERE are three kinds of experiments which seem to afford direct evidence regarding the nature of cosmic rays. These are: (1) the Bothe-Kolhörster double counter experiment, which compares the absorption of the particles traversing the counters with the absorption of cosmic rays; (2) measurements of the relative intensity of cosmic rays over different parts of the earth, designed to show any effect due to the earth's magnetic field; and (3) studies of the variation of cosmic ray intensity with altitude, which should follow different laws according as the rays are electrons or photons.

(1) The Bothe-Kolhörster experiment serves to measure the absorption in a block of gold or lead of the high-speed electrified particles that produce coincident impulses in two neighbouring counting chambers. It is found that this absorption is surprisingly small, about the same, in fact, as that of the cosmic rays themselves.

The simplest interpretation of this similarity in absorption is to suppose that the high-speed particles in question are the cosmic rays. There is, however, the alternative possibility that the primary cosmic rays are photons which eject high-speed electrons as recoil electrons when the photons are stopped, and that these recoil electrons are absorbed at about the same rate as the primary rays themselves. Theoretical calculations indicate that the recoil electrons should be absorbed five or ten times as rapidly as the photons which give rise to them. These calculations are somewhat uncertain because of extrapolation far beyond the wave-length region where the existing formulæ have been tested. For this reason, the equal absorption coefficients of the cosmic rays and the high-speed particles does not necessarily rule out the possibility that the particles in question may be recoil electrons excited by the cosmic rays. It would, nevertheless, be surprising if the formulæ were in error by so large a factor as five or ten, as would be implied if the coincidences are due to secondary electrons.

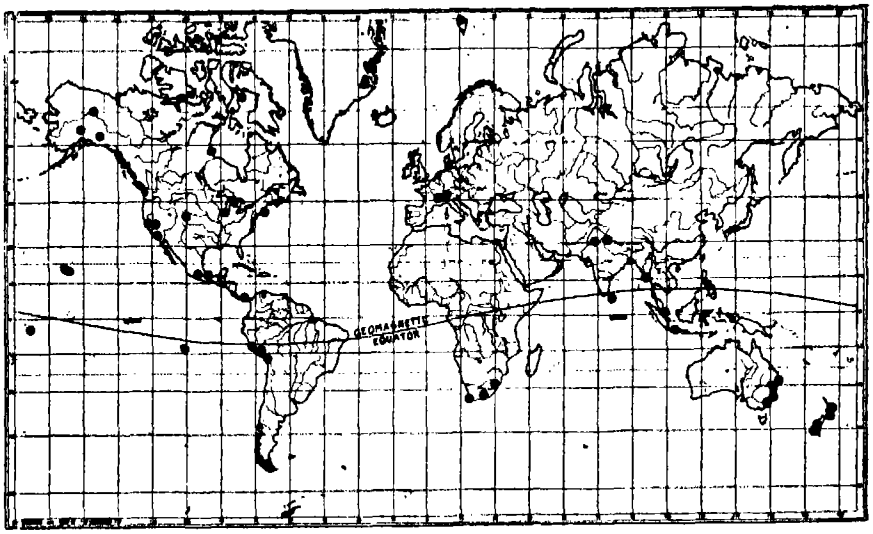

FIG. 1. Map showing major stations at which associated expeditions have made cosmic ray measurements during 1932.

(2) If the cosmic rays consist of electrified particles coming into the earth's atmosphere from remote space, the earth's magnetic field should affect their geographical distribution. This effect has been investigated theoretically by Størmer, Epstein, and recently much more completely by Lemaître and Vallarta. It appears that for energies less than 10^9 electron volts, electrons approaching the earth can reach it only at latitudes north of about 60°. For energies greater than about 5×10^{10} volts the geographical distribution is not affected by the earth's magnetic field. For intermediate energies, there will be a difference in intensity with latitude according to the distribution of energy of the incoming electrons.

Experimental studies of the relative intensity of cosmic rays in different parts of the world have been made by J. Clay, who made several trips between Java and Holland, and found consistently a lower intensity near the equator; Millikan and Cameron, who found but slightly lower intensity in the lakes of Bolivia than in the mountain lakes of California, and no difference between Pasadena and Churchill close to the north magnetic pole; Bothe and Kolhörster, who carried a counting tube from Hamburg (53° N.) to Spitsbergen (81° N.) and back, and detected no variations in the cosmic rays larger than their rather large experimental error; Kennedy, who, under Grant's direction, carried similar apparatus from Adelaide, Australia, to Antarctica, and likewise found no measurable change; and Corlin, who on going from 50° N. to 70° N. in Scandinavia found some evidence of a maximum at about 55° N. The prevailing opinion regarding the significance of these measurements has thus been expressed by Hoffman in a recent summary: "The results so far have on the whole been negative. Most of the observers conclude that within the errors of experiment the intensity is constant and equal, and those authors who do find differences give their results with certain reservations."

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* Substance of an address presented at a symposium on cosmic rays, held by the American Physical Society at Atlantic City on December 30, 1932.

During the past eighteen months, Prof. Bennett of the Massachusetts Institute of Technology, Prof. Stearns of the University of Denver, and I have organised a group of ten expeditions, with some sixty physicists, and we have attempted to make as extensive a study of the geographical distribution of cosmic rays as could be done in a limited period of time. Fig. 1 shows the position of the eighty-one stations in different parts of the world at which measurements have been made. These stations are about equally divided between the northern and southern hemispheres. They have extended from latitude 46° S. to latitude 78° N., and from sea level to about 20,000 ft. (Figs. 2 and 3). When these data are brought together, they show a marked difference in intensity between the cosmic rays at temperate and polar latitudes, as compared with the tropical latitudes. At sea level the difference in intensity is about 14 per cent, at 2,000 metres about 22 per cent, and at 4,400 metres about 33 per cent. The change between the intensity for tropical as compared with that for temperate latitudes occurs rather sharply between geomagnetic latitudes 25° and 40°.

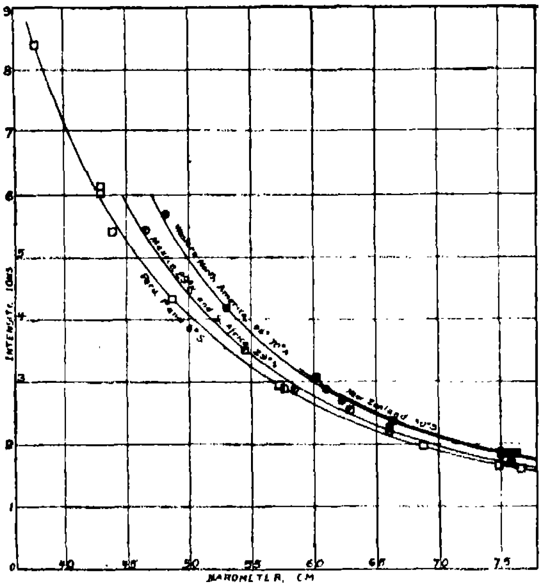

FIG. 2. Typical intensity-barometer curves, showing variation of intensity with altitude in different parts of the world. Circles, northern hemisphere; squares, southern hemisphere.

Comparison of the experimental data with the theory of Lemaître and Vallarta shows that the distribution of cosmic rays is about that to be expected if the rays consist of electrons entering the earth's atmosphere in two energy groups. One of these is of such great energy that it is not appreciably affected by the action of the earth's field. This group comprises in the temperate zone 88 per cent of the total radiation at sea level, and might, so far as these experiments are concerned, be classified as photons. At 4,400 metres this component constitutes 75 per cent of the total radiation. The second component is less penetrating and represents particles with an energy, if they are electrons, of about 7 × 10^9 electron volts. It is these particles which reach the earth at temperate latitudes but fail to reach it near the equator.

It may be remarked that even these less-penetrating cosmic rays have energies which are much larger than those that could be accounted for as recoil electrons resulting from photons, if these photons were to constitute the main body of the cosmic rays. According to Millikan, measurements of the absorption of the cosmic rays at sea level indicate that their energy, if they are photons, is of the order of 2 × 10^8 electron volts. This is so much less (a factor of 35) than that of the electrons responsible for the difference in intensity between temperate and tropical zones, that we would seem to be safe in concluding that the particles reaching the earth are not of the recoil type. On the other hand, the energy of 7 × 10^9

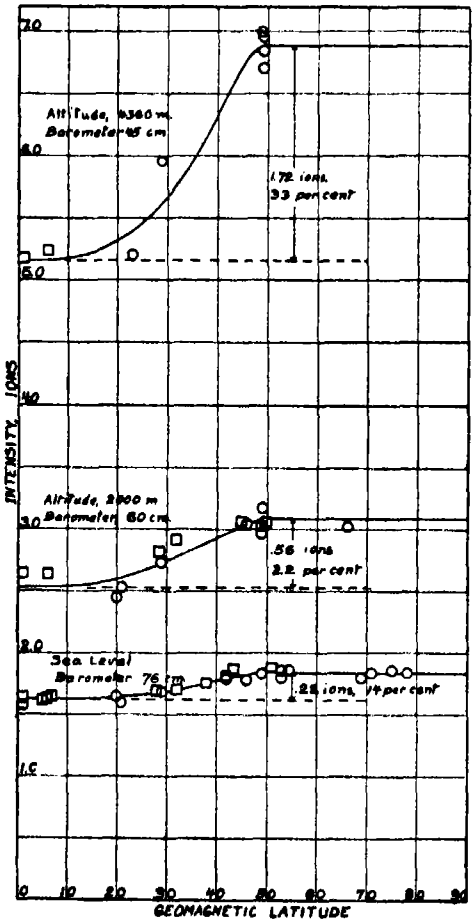

FIG. 3. Variation of cosmic ray intensity with geomagnetic latitude, as found for three different altitudes. The variation is more prominent at high altitudes. Curves calculated from Lemaitre-Vallarta theory.

electron volts demanded by the Lemaître-Vallarta theory for these particles would mean a range taken along the particle's trajectory of about three times the thickness of the earth's atmosphere. This is in accord with the fact that these rays penetrate the earth's atmosphere, but with difficulty.

This geographical study of the cosmic rays thus indicates that the less penetrating part of the cosmic rays, at least, consists of high-speed electrified particles. Regarding the more penetrating component, we conclude that if they are electrified particles, they must have an energy of 3×10^{10} electron volts or more.

(3) During the past two years, extensive experiments have been carried out studying the variation in the intensity of cosmic rays with altitude. The highest altitudes have been those reached by Regener with his sounding balloon and Piccard with his famous stratosphere balloon. We have also paid especial attention to this problem in our mountain experiments. In Fig. 4 the data from mountain and balloon observations are compared. These data show a rapid increase in intensity with altitude, continuing nearly exponentially to an altitude of 15 km., and from there approaching a limiting value as the apparatus is carried close to the top of the atmosphere.

If we suppose that the cosmic rays enter the earth's atmosphere as photons, any secondary electrons that may have been associated with them in space will have been removed by the action of the earth's magnetic field. We should thus have a beam of pure photons entering the atmosphere. At the surface of the atmosphere these photons will produce very little ionisation, for the ionisation results directly from the secondary electrons that pass through the chamber. The secondary electrons, however, arise only at the absorption of the primary photons, and will not approach their normal intensity until the photons have traversed a thickness of air about equal to the range of the electrons. This means that at very high altitudes the ionisation due to a beam of photons entering the earth must be almost zero. The ionisation current should rather approach a maximum at a depth in the atmosphere at which the cosmic rays are somewhat less than half absorbed, and should then gradually diminish in intensity as sea level is approached. Our high mountain experiments confirm the recent balloon experiments as indicating that no such high altitude maximum exists. This would seem to rule out the possibility that the cosmic rays can be photons entering the earth's atmosphere from remote distances.

If we suppose, on the other hand, that the cosmic rays are electrons entering the atmosphere from above, we should expect very much the kind of intensity-altitude curve that the present experiments show. It is well known that the ionisation per unit path by high speed electrons remains almost constant over a wide range of energies. Thus, if a beam of such electrons enters the atmosphere, it will produce nearly uniform ionisation down to such depths that an appreciable number of the electrons are stopped by the air. If the initial electrons were all travelling downward, there would be a rather definite limit or range where there would be a rapid reduction in the ionisation by the cosmic rays. If, however, the initial electrons entered in all directions, some of them would be stopped even in the upper layers of the atmosphere. Thus, supposing that the cosmic rays consist of electrons entering the earth's atmosphere from outer space, the general characteristics of the intensity-altitude curve can be readily accounted for.

If Regener's measurements from his balloon flights during the past summer are reliable, it appears that there is no detectable decrease in ionisation as the top of the atmosphere is approached. This would mean, in accord with the above reasoning, that no appreciable portion of the cosmic rays enters the earth's atmosphere in the form of photons.

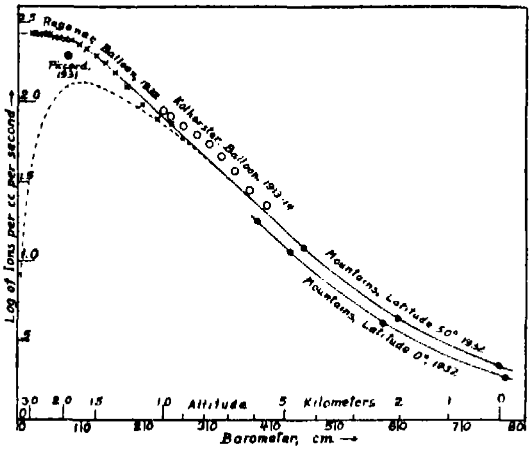

FIG. 4. Combined balloon and mountain data on intensity as function of altitude. Broken line, anticipated values for photons.

On the other hand, if the cosmic rays enter the atmosphere as electrons, they will produce photons just as cathode rays striking a target produce X-rays. Accordingly, at lower altitudes a mixture of electrons and photons will be present, and it may be expected that the photons will have the greater penetrating power. It is thus not impossible that the very penetrating cosmic rays observed by Millikan, Regener, and others at great depths under water may be such photons excited by the incoming electrons.

Although we have discussed the problem as if the electrified particles which seem to constitute the cosmic rays are electrons, it will be understood that the experiments that have been cited do not serve to distinguish between negatively and positively charged particles. The experiments are equally consistent with the view that the rays consist of protons or high speed α-particles. I find no way of reconciling the data, however, with the hypothesis that any considerable portion of the primary cosmic rays consist of photons.

The Old Ashmolean, Oxford

By T. E. JAMES

IN celebration of the occasion of the two hundred and fiftieth anniversary of the opening of the Old Ashmolean, Oxford, which falls on May 21, a series of events has been arranged. Addresses will be presented on May 22, by delegates of scientific and literary institutions, whilst a lecture is announced for the same day by Sir Arthur Smith Woodward on "Plot and Lhwyd and the Dawn of Geology". This will be delivered in the University Museum. Various exhibitions which are of cognate interest in connexion with the anniversary will be available to the public.

As an event of importance in the history of early science in Great Britain, but more particularly, perhaps, in relation to natural history, it is well and fitting to look back and recall the mode of origin of the Old Ashmolean. Time has changed much that was characteristic of this institution, leaving it now, one might almost say, no more than a dignified relic of the past. There is also something to record that is needful, respecting Elias Ashmole, the founder of the original *Musaeum Ashmoleanum.*

"Alumni Oxonienses" supplies a conveniently brief and helpful summary, where space is limited, of the main features of Ashmole's varied career. It runs :—"Born Lichfield 23 May, 1617. Educated Lichfield Grammar School. A chorister of Lichfield Cathedral; solicitor in Chancery, 1638; of Clement's Inn, 1640; an Attorney of the Court of Common Pleas, 1640; a Captain in Lord Ashley's regiment of foot at Worcester, 1646; barrister-at-law of the Middle Temple, 1660. Windsor Herald, 1660. Chief Controller of H.M. Excise in England and Wales, 1668. D.Med., by diploma (Oxon), 1669—." The anniversary of Ashmole's date of birth thus falls on the day after Sir A. Smith Woodward's promised lecture. Ashmole died on May 18, 1692, and he was interred in South Lambeth Church, where a black marble slab commemorates him in eulogistic terms. He had married three times, his third wife (1668) being the daughter of Sir William Dugdale.

Elias Ashmole, "skilled in chemistry, antiquities, heraldry, mathematics", and other abstruse studies, including alchemy and astrology, was among those persons, who, on May 20, 1663, were registered, and declared to be original fellows of the Royal Society, following upon the incorporating Charter of July 15, 1662. Ashmole's name, however, was included in that earlier and historic list of supporters of a proposed new society, whose declaration ran—"Wee whose names are underwritten doe consent and agree that wee will meete together weekely . . . to consult and debate, concerning the promoting of Experimentall Learning". This was dated, in the first instance, December 5, 1660, but names were appended after that particular date. On December 26, 1660, there is a minute that "Mr. Boyle, Mr. Henry Oldenburg, Mr. John Denham, Mr. Rawlins, Mr. Elias Ashmole, Mr. John Evelyn, and Nathaniel Henshaw, M.D., were proposed candidates for election". The association of Ashmole with these pioneer promoters of the new philosophy is of special though incidental interest. Ashmole not only signed the document quoted above, but also the Charter Book, when that fellowship roll was received and inscribed by original fellows as for 1663.

Hence, the Royal Society has two testifying signatures of Elias Ashmole. In election he preceded Edmund Waller and Abraham Cowley. On the other hand, Ashmole never served on the Council; nor did he appear to advance any schemes at hand. But he had divers interests and occupations as just excuse. Still, as regards activities in early science at Gresham College, or at Arundel House, Ashmole is a disappointing study.

In other directions, however, Ashmole's personal equipoise was assured. On June 18, 1660, he was introduced to the presence of King Charles II by no less a functionary than Thomas Chaffinch; and on the next day he was constituted Windsor Herald. When that folio on the History of the Most Noble Order of the Garter was published (1672), it was brought to the King by Ashmole.

We may now briefly consider Ashmole's connexion with the Old Ashmolean, and how it came to be established at Oxford, where scientific studies had already begun. On one of the rural sides of London, at South Lambeth, there had been established, by 1629, an extensive botanic garden, an adjunct to a residence, the latter a repository for 'rarities' in natural history. It was the home of John Tradescant, whom we hear of as married in 1607 at Meopham, in Kent. First as a gardener helping to stock the Hatfield demesne, next, he is travelling abroad and collecting assiduously, encouraged and stimulated by the Duke of Buckingham. It was the Duke's wish (so wrote Tradescant in 1625), that "I should deal with all merchants from all places". The South Lambeth house came, in time, to be known by the suggestive title of 'Tradescant's Ark'; its collections were noteworthy in the infancy of the study of natural history in England.

John Tradescant, son and heir, was imbued with his father's tastes and likings, and he carried on the collecting work at Lambeth when his father died in 1637. A decade or so later, we find that Ashmole was a frequent visitor across the Thames, and became very friendly with John Tradescant. In 1659 a diary entry by Ashmole records, "Mr. Tradescant and his wife told me they had been long considering upon whom to bestow their

Closet of Curiosities when they died, and at last had resolved to give it unto me".

After the death of John, the husband (1662), acute trouble arose in regard to the collections, settled, however, by Lord Chancellor Clarendon, in 1664, in favour of Ashmole, who was to "have and enjoy" the collection of rarities. Ashmole was then living in a house next to the Tradescants.

After Ashmole had obtained possession of the repository there came a period (about 1677), when it was urgently necessary to assign its contents. There were also certain manuscripts and books thought worthy. It was no use to cast eyes towards Gresham College. It was therefore not unreasonable, he thought, to offer his possessions to Oxford, his *alma mater*, but *conditionally* on the erection of a building to house them. He had been much honoured there in 1669 as a "curioso and virtuoso". Certainly a bold proposition, all things considered; nevertheless, it was gratefully accepted. Thereafter, the Ashmolean building took shape and became the designated habitation, erected at the charge of the University, fulfilling, at least in some measure, Ashmole's original hopes.[*] The foundation stone was laid on Thursday, May 15, 1679, and the Museum was opened on May 21, 1683. The Duke and Duchess of York, and their retinue, attended. There was feasting and jollity, and Ashmole (with whom was Mrs. Ashmole) was applauded and favoured to the top of his bent. Dr. Plot, the first custodian, gave a "sette speech". After the chief ceremony, the company went down to a newly fitted chemical "elaboratorie", where they witnessed some experiments, which are recorded as having given great satisfaction. A revival of the activities of the philosophers forming the Philosophical Society of Oxford, the original members of which had close contact with the Royal Society in London, occurring, their meetings were held in the Ashmolean for some time, and were both profitable and inspiring.

Space will not allow reference to the vicissitudes which later waited upon the Old Ashmolean, ending in neglect and disrepair. Dr. R. T. Gunther has dealt with these points, and of a brighter period, bringing in its train appreciation of new uses and recognition of the historic past.

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[*] On January 26, 1678/9, a fire in the Middle Temple destroyed Ashmole's library, and many curios, in all probability, destined for Oxford.

Obituary

THE DUKE OF THE ABRUZZI

FEW men have led lives so full of interest and accomplishment as Prince Luigi of Savoy, Duke of the Abruzzi, who died on March 18 at the age of sixty years. Mariner, explorer, admiral, colonist, and man of science, he exhibited vision and initiative in every field of his numerous activities, and, by sheer tenacity of purpose, achieved success in the most arduous of ventures.

The Duke's connexion with the Italian navy commenced in 1879 when, at the age of six, he entered the service as cabin boy. From 1884 until 1889 he was occupied in study at the Royal Naval Academy. In those days Italy was not very well known in foreign countries and, to remedy this, the ships of the navy were sent on missionary work to distant lands and even round the whole world. Such patriotic propaganda found an enthusiastic supporter in the young Prince who, in the *Amerigo Vespucci*, the *Volturno*, and the *Cristoforo Colombo*, took part in several long voyages, ultimately attaining the rank of lieutenant. His first important naval command, in 1902, was that of the cruiser *Liguria*, in which he made a tour of the world lasting eighteen months. Further promotions followed, and the Duke commanded a squadron during the Italo-Turkish war of 1911–12, and was appointed to the supreme command of the Italian navy during the War.

As a traveller and explorer, the services of the Duke of the Abruzzi to science and to his country were outstanding. His early education in this direction was acquired during his teens in the Alps under the guidance of the well-known alpinist, Francesco Gonella. The Alps were also the scene of many of his later ascents and before he reached the age of thirty he had climbed, in some cases during the winter, all the most difficult Alpine peaks, some of which had not been previously conquered.

During his world-tour of 1894–96, the Duke saw the Himalayas for the first time and on his return to Italy he made preparations for an ascent of Nanga Parbat (8,115 metres). This expedition was, however, frustrated owing to an outbreak of plague and famine, which decimated the Punjab. The objective was therefore changed to a peak very different in character, Mount St. Elias in Alaska. Unlike Nanga Parbat, with a lower snow limit at about 5,000 metres, Mount St. Elias is covered from base to summit with glaciers, which debouch into the waters of the Pacific. The mountain—which is visible from the sea at a distance of 200 miles and has been known to navigators since the beginning of the eighteenth century—and its immediate surroundings were at that time completely unexplored. The expedition, consisting of the Duke and five companions, together with four Alpine guides, left Italy in May, 1897, and was joined at Yakutat Bay by ten American porters. Three days were occupied in crossing the wide plateau of the Malaspina glacier, and four laborious weeks in traversing the Seward, Agassiz, and Newton glaciers, fissured by enormous crevasses. Just over ten weeks after leaving Italy, the party camped beyond the Newton glacier at the foot of the great pyramidal mass of the mountain, and less than three days later reached the summit without casualty.

The observations made gave the altitude of

Mount St. Elias as 5,514 metres, in good agreement with the value (5,516 metres) calculated by Russell who, in 1891, reached a col situated at a height of 3,745 metres. Two unknown snowy peaks, observed in the west, were named Lucania and Bona, these being identified topographically and measured sixteen years later by American observers. A series of meteorological and glaciological observations was made, and collections of the minerals and minute fauna of the glaciers, and the first complete series of views of the St. Elias group were secured.

In the summer of 1898 the Duke visited Spitsbergen and in the following winter made an excursion by sleigh into Central Siberia. Preparations were then made—quietly, indeed almost secretly—for a north polar expedition. It was decided not to follow the plan adopted by Nansen in his earlier attempt, but to proceed by ship as far north as the currents allowed and then set out on foot. A Norwegian sealing vessel, re-christened the *Stella Polaris*, was acquired and the party of eleven Italians, with a Norwegian crew of nine, sailed in July 1899 from Archangel, where the sleigh-dogs had been shipped. Franz Josef Land was reached in three weeks' time and the ship proceeded through the archipelago to cast anchor off Prince Rudolph Island (lat. 82° 4′ N.), the most northerly island of the group. The ship narrowly escaped destruction in the ice, but was ultimately brought into a position of safety, and winter quarters were constructed on the island. During one of the trial sledge trips, the Duke was attacked by frost-bite, followed by gangrene, which necessitated the amputation of two fingers. It was not until about four months later that the weather allowed of the dispatch of the sleigh party. This was divided into three groups, to return at intervals. The first group of three, under Lieut. Querini, never came back, but Capt. Cagni's group, who were absent from the camp for 104 days, reached lat. 86° 34′ N., thus surpassing Nansen's record. In spite of the many difficulties encountered, the expedition was away only fourteen months, at that time the shortest period for a polar expedition.

Other expeditions organised by the Duke were those to Ruwenzori, in Central Africa, in 1906, when twelve peaks, all exceeding 4,600 metres, were ascended, measured and mapped; to the Karakoram Himalayas in 1909, when Bride Peak was climbed to a height of 7,500 metres (the highest altitude reached up to that time), the attempt to cover the remaining 150 metres having to be abandoned; and to the sources of the Webi Shebeli River, which flows through Ethiopia and Somaliland. On all these expeditions much valuable information of interest, not merely to geographers, but also to the whole scientific world, was collected and published. Their uniform success was due to the minute care taken in the preliminary preparations and, particularly, to the enthusiasm which the Duke showed and imparted to every one of his companions in every exploit he undertook.

The Italian Mission to the Abyssinian court in 1927 was led by the Duke, who later paid a second visit to the Webi Shebeli River and surveyed large areas in Abyssinia. Somaliland, where he had a large farm, claimed a good deal of his attention, and it was to his work on irrigation and on improvements in other directions that the opening up of this country was largely due.

Born in Madrid on January 29, 1873, shortly before the abdication from the Spanish throne of his father, Duke Amedeo of Aosta, brother to King Humbert of Italy, he passed away, after a life of ceaseless activity, in Somaliland, to the colonisation of which so much of his energy was devoted.

DR. JULIUS SCHMIDT

WE regret to learn from the *Chemiker-Zeitung* of the death of Dr. Julius Schmidt, extra-ordinary professor of organic chemistry at the Technische Hochschule in Stuttgart and director of the Chemistry Laboratory at the Höhere Maschinenbauschule in Esslingen, aged sixty-one years. A native of Baiersdorf in Bavaria, Schmidt studied under Knorr at the University of Jena and graduated in 1894. In 1900 he was appointed lecturer in organic chemistry at Stuttgart, where he carried out numerous investigations in the field of organic chemistry. His researches dealt particularly with nitroso-compounds, oximes and quinones, and with derivatives of phenanthrene and fluorene. He was also the author of numerous books and pamphlets on alkaloids, quinones, nitroso-compounds, organic magnesium compounds and pyrazoles. He also published a handbook of organic chemistry, which has been translated into English, and a yearbook of organic chemistry.

WE regret to announce the following deaths:—

Prof. Victor Goldschmidt, honorary professor of mineralogy in the University of Heidelberg, on May 8, aged eighty years.

Dr. William H. Holmes, formerly chief of the Bureau of American Ethnology and director of the National Gallery of Art, Washington, distinguished as a geologist, and a pioneer in field work in the archæology of North and Central America, on April 21, at the age of eighty-six years, at Royal Oak, Michigan, following on a paralytic stroke.

Dr. Leonard Huxley, editor of the *Cornhill Magazine*, author of "Life of Huxley", "Life of Sir Joseph Hooker", "Thomas Henry Huxley, a Character Sketch" and "Charles Darwin", on May 3, aged seventy-two years.

Mr. John Mackereth, a deputy conservator in the Indian Forest Service, on May 5, aged thirty-four years.

Prof. J. T. J. Morrison, emeritus professor of forensic medicine and toxicology in the University of Birmingham, on May 10, aged seventy-six years.

News and Views

Temperature below 0·27° K. reached in Holland

As we go to press, the following communication signed by Prof. W. J. de Haas and E. C. Wiersma of Leyden, and Prof. H. A. Kramers, of Utrecht, and dated May 15, has been received: "Debije has indicated a method of reaching very low temperatures by means of the adiabatic demagnetisation of paramagnetic salts. We have applied this method to CeF$_3$ with complete success. We determined a susceptibility curve in the region of temperatures usually reached with liquid helium, and by extrapolation from this curve in such a way that the result can only be too high, we found that the temperature reached in the adiabatic experiment was certainly below 0·27° K., even when the saturation was not taken into account. The other method of lowering the temperature, by reducing the vapour pressure of liquid helium, has resulted in a temperature of 0·82° K. reached by Kamerlingh Onnes, and later in one of 0·71, reached by Keesom."

Wool Industries Research Association

THE report of the Council of the Wool Industries Research Association, Torridon, Leeds, for 1932–33 refers to the satisfactory working of the voluntary levy scheme, the yield from which during the year has increased by 10 per cent. Subscriptions from the industry have reached the record figure of £11,087, or £514 in excess of the previous year. Together with a further reduction in expenditure due to certain internal economies and a new arrangement for the printing of publications and abstracts, this increase has enabled the Association to show a surplus for the year in spite of a reduction of £2,500 in the grant from the Department of Scientific and Industrial Research. Owing to economies effected by the Association in its work on raw wool during the last two years, the Empire Marketing Board has been able to extend the period of the grant for this work until September, 1933. The activities of the Wool Fibre Research Committee have been continued and representative samples of New Zealand wools have been selected as standards and submitted to New Zealand.

TRIALS carried out in Great Britain and in all parts of the Dominions of a sheep-marking fluid devised by the Association have proved the ability of the fluid to meet all the requirements of both the farmer and the manufacturer, in that it withstands climatic conditions satisfactorily and yet is completely removed from the wool by ordinary commercial scouring methods. Attempts have been made to render the present jute wool pad innocuous by impregnation, using a cellulose and a rubber latex dope. Both gave very promising results on trial in Australia and further experiments are being conducted on the same lines. Other experiments indicated that no real saving could be made on the weight of the fabric if the strength and durability were to remain unimpaired. Work on the standardisation of the methods of testing the fastness of dyed materials has continued under the supervision of a joint committee of the Association and the Society of Dyers and Colourists, and light standards consisting of seven red and seven blue colours on wool have now been finally selected.

Study Group on Managerial and Administrative Problems

INCREASING attention is now being devoted to the scientific treatment of the problems which arise in the management and administration of industry, and with the object of promoting discussion on these problems, a study group has been inaugurated under the leadership of Mr. W. R. Dunlop. Membership is being drawn mainly from among those who have attended Mr. Dunlop's course of training for management, though others who possess a degree in natural science or its equivalent and have taken a comprehensive course in management will be eligible to join. The latter qualification may be waived in special cases where a scientifically trained man has had managerial or administrative experience. The group is to be in the nature of an informal society and will meet regularly every three months, and in between as may be arranged, at 57 Gordon Square, London, or some other suitable place. The main feature of the meetings will be the scientific discussion of managerial and administrative problems and difficulties, especially in those industries in which science plays a predominant rôle. A monthly bulletin sheet will be distributed privately to members. This will contain items of managerial interest and references to new literature, while, for the benefit of country members, there will be included a summary of the proceedings at each meeting.

International Congress of Anthropological and Ethnological Sciences

IN accordance with a previous announcement, a conference was held at Basel on April 20–22 with the object of organising an international congress of the anthropological and ethnological sciences. Local arrangements were in the hands of Dr. F. Speiser of Basel and those who attended were received by Dr. F. Hauser, director of education, on behalf of the city of Basel and by Prof. Ernst Staehelin, Rector of the University of Basel, on behalf of the University. Twenty-three delegates, representing nine nationalities, were present and promises of support had been received from a large and representative number of anthropologists. Prof. J. L. Myres (Oxford) was elected president of the conference and Dr. Speiser and Mr. Houghton Brodrick (London), secretaries. Although some of the delegates expressed a strong preference for two separate congresses, to cover the anthropological and ethnological sciences respectively, it was decided that: (1) an international congress of anthropological and ethnological sciences be established; (2) the first congress be held, if possible, in 1934, and thereafter at intervals of four years; (3) on the invitation of the Royal Anthropological Institute, supported by the Joint

Committee for Anthropological Research and Teaching, the first congress be held in England, probably in London, in 1934. Draft statutes prepared by the president, the secretaries and Profs. Krause and Mauss, following closely the lines of the statutes of the International Congress for Prehistoric and Protohistoric Sciences, were considered and adopted. After nominations to the *comité d'honneur*, the permanent council and the offices of national secretaries, and votes of thanks to the City, the University and those who had been responsible for the work of the conference, the conference dissolved. A report of the meeting will be found in *Man* for May.

Radio Research in Great Britain

THE facilities for radio research carried out by the Department of Scientific and Industrial Research on the advice of the Radio Research Board have been improved by the unification of the Wireless Division of the National Physical Laboratory and the Department's Radio Research Station at Slough into a new Radio Department of the National Physical Laboratory. Mr. R. A. Watson Watt, hitherto superintendent of the Radio Research Station, is the superintendent of the new department. On the formation of the Radio Research Board in 1920 the National Physical Laboratory was entrusted with all work which required a laboratory equipped with instruments of the highest precision. Such work included the development of radio frequency standards, the study of problems of selectivity, aerial arrays and the generation of extremely short waves, as well as methods for the measurement of fundamental quantities necessary in accurate circuit design. Work requiring measurements in the field or on isolated sites was carried out at the Radio Research Station at Slough. The latter, which now ceases to be a separate research establishment of the Department of Scientific and Industrial Research, has, during its independent existence, earned an international reputation mainly in connexion with the researches carried out there on the travel of wireless waves, the electrical properties of the upper atmosphere, and the nature and origin of atmospherics.

A London Super Power Station

THE Battersea Power Station, which forms such a prominent landmark on the south side of the River Thames, will soon come into operation. It has been erected by the London Power Co., which was formed to secure the co-operation of the London electricity supply companies so as to reduce the cost by concentrating the generation of electricity in more efficient stations. It is one of the 'selected' stations adopted by the Central Electricity Board to supply the south-east of England electricity area. A description of it is given by I. V. Robinson in *World Power* for May. At present the station possesses two 70,000 kilowatt turbo-alternator sets and a 100,000 kw. set has been ordered. There are six Babcock and Wilcox boilers each evaporating 330,000 lb. of steam per hour at a pressure of 650 lb. per square inch and a temperature of 875° F. A jetty has been built parallel to the wharf which accommodates two of the company's 2,000-ton colliers at once. The coal is extracted by grabs and deposited on conveyors which take it to the boiler-house. Owing to the vicinity of the Houses of Parliament, Westminster Abbey, etc., it was necessary to take precautions so that the fumes would not act harmfully on these buildings. By means of induced draught fans the products of combustion are forced through 'scrubbers', passing across vertical surfaces in which water is flowing. They next pass over the main scrubbers consisting of cases of iron filings over which a stream of water flows. The iron acts as a catalyst converting SO_2 into SO_3. On reaching the chimney the gases first pass down a central chamber containing more steel sections and so have more oxide of sulphur abstracted. They then meet water containing alkaline salts which completes the purification. It is computed that 90–95 per cent of the oxide of sulphur has been eliminated.

The Cahn Hill-Improvement Scheme, Wales

LAST summer Sir Julien Cahn came forward with his generous response to the appeal made by the Welsh Plant Breeding Station of the University College of Wales for assistance towards the important work in progress relative to the improvement of hill land. The work had arrived at the stage when it was essential to conduct large-scale experiments involving not only the improvement of the grazing but also the control and management of the animals on somewhat novel lines. It was therefore necessary that the Station should obtain possession of suitable lands for the purpose, and that Prof. R. G. Stapledon should have associated with him a man fully competent in the management and breeding of stock. Mr. Moses Griffith, recently the agricultural organiser for Merionethshire and a well-known breeder of Welsh black cattle, has, therefore, been appointed to assist Prof. Stapledon as lands director to the scheme. A lease has been entered into with the Hafod Estate, for an area of approximately 2,700 acres of hill land. This comprises a mountain sheep walk of more than 2,000 acres together with a hill farm consisting of hill and cultivated land. The area chosen is on an estate with a long pioneering history behind it; for already at the end of the eighteenth century Johnes of Hafod was planting trees amongst these inhospitable hills and devoting himself with enthusiasm to improving the agricultural conditions of the district. Operations have been started and it is hoped that at least 50 acres of hill will be grassed out during the next two months. Each succeeding year large areas will be taken in hand by the methods which have been developed as the result of experiments conducted by Prof. Stapledon in various parts of Wales during recent years. In addition to the land at Hafod, possession has also been taken of about 70 acres of hill land near Knighton, in Radnorshire, and operations will be started there in the autumn.

Spike Disease in Sandal

SANDAL has long been a valuable forestry product in southern India and the mysterious disease termed 'spike' has been the subject of investigation during the past quarter of a century. Various bodies interested in sandal are collaborating, such as the Madras Forest Department, the Indian Institute of Science at Bangalore, the Forest Research Institute at Dehra Dun and others. A report on the progress made during the half-year ending September 30, 1932, entitled "Investigations on the Spike-Disease of Sandal" has been issued by the Institute of Science, Bangalore. The sporadic attacks of this pest have a strange parallel to those of foot and mouth disease in Great Britain. A recrudescence of the disease in an epidemic form has been noticed in the Beedamaruthupatti spike area. Pollarding, which has been carried out on a fairly large scale in the Galigattam and Manchi areas, has yielded significant data. So far, Manchi has the maximum percentage of disease-masking sandal plants. The entire freedom from infection of a few areas, Sanamavu and Thalli in North Salem and Chickabettakere in Coorg, has been established by pollarding. More detailed technical contributions will appear as scientific papers in the *Journal of the Indian Institute of Science*, *Dehra Dun Forest Research Publications*, and elsewhere. Meanwhile it is a valuable departure to issue progress reports so that the various investigators studying the pest, which causes so heavy a financial loss, should have early news of any results achieved.

Poison Control and its Effect upon Wild Life

IN California the control of the ground squirrel (*Citellus beecheyi*) by poison has given rise to strong protests in journals devoted to ornithology and bird protection, on account of the death by poisoning of numbers of wild creatures which are not injurious. We have already referred to some of these articles, and in fairness, it ought to be stated that the California Department of Agriculture, which is responsible for the organisation of the poisoning measures, accepts neither the "facts" nor the conclusions of the writers. In a summary of "The California Ground Squirrel Control Program", Eugene S. Kellogg states that those in charge of rodent operations were anxious to know what effect thallium, exposed on bait for ground squirrels, might have on other species of wild life, or how it might act as a secondary poison on predatory animals and birds. To check this point, the Biological Survey made a careful census of the wild life, then exposed baits far heavier than necessary for existing ground squirrel population in order to learn wild life tolerances. Careful checking by several observers during thirty days failed to show an appreciable effect on the beneficial animal life of the area. Hawks, quail and mourning doves, the species watched most carefully, appeared to be as numerous at the conclusion of the test as before (California Dept. Agr. Special Pub. No. 109). In this clash of opinion it is impossible for the outsider to discover exactly where the truth lies ; our impression is that there is a certain amount of bias on each side and an absence of the scientific detachment which would carry conviction. A basic fact which cannot be ignored is that ground squirrels are an economic pest which somehow must be controlled.

Smithsonian Field Expeditions in 1932

NONE of the many-sided activities of the Smithsonian Institute appeals so much to the imagination as the explorations and field work. During 1932, twenty-five expeditions were sent out or participated in for research in anthropology, biology, geology and astrophysics. These expeditions visited thirteen States of the United States, Europe, Canada, Alaska, Mexico, Hispanola, Jamaica, British Guiana and South-West Africa. Amongst the more interesting were a trip to various mining localities in Mexico for the collection of certain rare minerals and ores, a bird-collecting expedition to Hispanola, and a continuation of anthropological work in Alaska, where the characteristics of the living natives were studied, and the skeletal and archæological relics of an earlier civilisation were unearthed by excavation. The reduction in the Institute's income, both private and governmental, has occasioned strict economy in all lines and curtailment of some activities. Funds for publication have been cut nearly to one-half of the previous year's amount, with the result that valuable manuscripts have had to be refused or held up for a year, and the annual report, from which we have quoted above, has itself been cut to half its normal size. If the economies which must be enforced in other countries as well as in the United States, lead to the condensation of the published records of scientific work in some cases, and in other cases to more rigorous selection for publication, the experience will not be altogether wasted.

Agricultural History in Germany

THE Agricultural History Society of America, referred to in NATURE of March 19, 1932, p. 432, has a German counterpart in the Gesellschaft für Geschichte und Literatur der Landwirtschaft. Membership of this society is open to all persons interested, the subscription for persons resident outside Germany being 4 RM. per annum. The society's inquiries are not confined to central Europe. Investigation of the history of prominent agriculturists and of farms that have been in long-continued ownership by one family are noteworthy aspects of its activity. It publishes a small quarterly (free to members) containing articles, reviews and a list of current books and papers. Recent issues have included articles on the measures devoted to the development of Chinese agriculture under the Mongols, the Swiss Peasant Association, and the use of marl in ancient and medieval times. Information regarding the society can be obtained from Prof. W. Seedorf, Gosslerstrasse 16, Göttingen, Germany.

New Record for Deep Drilling

THE issue of the *Oil Weekly* of May 1 gives details of the establishment of a new depth record of 10,668 ft. for oil-well drilling, which has been achieved on the Kettleman Hills Field, California. This depth exceeds the previous record by 83 ft. The well has been drilled with standard rotary equipment and, so far, a 5⅝ in. hole is being made. It is destined to go to 11,000 ft. or even deeper if an oil-producing zone is not discovered at a shallower depth. One of the geological factors influencing the depth of this well is the great thickness of the recent deposits overlying very hard shale (Kreyenhagen). Operators believe in the possibility of very deep production at Kettleman Hills, and this is the first really serious attempt which has been made to test the lower formations in this region.

Asparagus Growing

THE imposition of a tariff on certain imported fruits and vegetables has made it possible for English growers to produce certain crops which before were unprofitable. One of these is asparagus, and it is therefore particularly opportune that the Ministry of Agriculture has issued a Bulletin (No. 60, "Asparagus", 1s. net) which deals with its cultivation and marketing. A useful preliminary account traces the history of asparagus from Roman times and also outlines the botany of the plant. Varieties are described in fair detail and experiments on the use of unisexual plants are outlined. Male plants tend to give a large number of buds whilst female plants produce fewer but larger sticks. Methods of cultivation in Italy, France, Germany, the United States and England are given, and marketing is also discussed. The main pest of asparagus, the asparagus beetle, is described, as are also several fungus diseases. The canning industry is growing in England, and its needs have been borne in mind by the writer of the bulletin.

Legal Medicine in the United States

THE resources of the various States of the Union for dealing with medico-legal problems in the administration of justice have been examined by a committee of the National Research Council, and the results of this survey are contained in a volume recently issued (Bull. Nat. Res. Council, No. 87, National Academy of Sciences, Washington, D.C., 1.50 dollars). It is pointed out that the determination of the cause of death, when a medico-legal question is involved, is the work of the skilled pathologist, who should be in a position to call to his aid the resources of bacteriologist, toxicologist, chemist, and others. Determination of mental responsibility is the work of the skilled psychiatrist. The detection of crime may at times require the application of pure and applied sciences in addition to the medical sciences. In the United States, there is as yet nothing comparable to the first-class medico-legal institutes of Europe.

Relativity

THE addresses and discussions at the conference on relativity in May 1930, which Prof. P. Langevin organised and presided over, have been published by Messrs. Hermann of Paris in the form of pamphlets of 14–30 pages at 6 or 7 francs in their series of Actualités Scientifiques et Industrielles. The principal titles are:—"Cinématique de la Relativité" by M. E. Bauer of the Collège de France, "L'Inertie de L'Énergie" by M. F. Perrin of the Faculté, "Méchanique Ondulatoire" by Prof. L. de Broglie of the Sorbonne, "La Théorie Einsteinienne de la Gravitation" by Prof. G. Darmois of the University of Nancy, "La Théorie Unitaire du Champ" by Prof. E. Cartan of the Sorbonne and "La Relativité" by Prof. P. Langevin. In all cases the subject is presented in a very readable form and Prof. Langevin's address summing up the general results is especially interesting. He also contributes a simple proof of the Lorentz transformation to the discussion on the kinematics of the subject.

Announcements

THE Bakerian lecture of the Royal Society will be delivered on Thursday, May 25, at 4.30 p.m. by Dr. J. Chadwick, who will take as his subject "The Neutron".

ON account of alterations and repairs which are being made to Flamsteed House, the official residence of the Astronomer Royal, it will not be possible this year to hold the customary garden party at the Royal Observatory on the occasion of the annual visitation by the Board of Visitors on Saturday, June 3.

THE annual congress of the South-Eastern Union of Scientific Societies will be held at Norwich on June 7–10. The president-elect is Prof. E. J. Salisbury, Quain professor of botany in University College, London. The presidential address is entitled "The Influence of Man on Vegetation". The congress will be divided as usual into the following sections: geology, botany, archæology, zoology, and regional survey. Several interesting excursions have been arranged in connexion with the congress. The local secretary is Dr. H. A. Castigan, principal of the Technical College, St. George Street, Norwich.

THE fourth International Congress of Radiology will be held in Zurich, under the presidency of Prof. H. R. Schinz, professor of radiology in the University of Zurich, on July 24–31, 1934. Members of radiological societies in all countries, and other persons introduced by such societies, are eligible for membership. At the general meetings the following subjects will be considered, among others: radiation genetics; mitogenetic radiation; structure analysis; identical physical measurement of the dose in X-ray and radium treatment; hard gamma-rays, cosmic radiation, earth radiation; and short-wave therapy. During the Congress, an exhibition of apparatus, photographic accessories, chemical products and scientific books will be on view. The general secretary of the Congress is Dr. H. E. Walther, Gloriastrasse 14, Zurich.

THE third International Congress of Linguistics will be held at Rome on September 19–26. The Congress will meet in three sections, of which the first will deal with general questions, the second with the Indo-European languages, and the third with the non-Indo-European languages. An organising committee has been formed, which is responsible for the arrangements for the meeting, of which the chairman is Prof. Matteo Bartoli and the secretary Prof. Bruno Migliorini. Subscriptions (members, 50 lire; associates accompanying members, 25 lire) should be addressed to the treasurer of the Congress, Prof. Vittore Pisani, Commizzione Nazionale italiana per la co-operazione intelletuale, via del Conservatorio, Rome (115). It is announced that the proceedings of the second Congress, held at Genova in 1931, are in the press and will be issued shortly.

DR. WITMER STONE, vice-president of the Academy of Natural Sciences of Philadelphia and curator of its Department of Vertebrate Zoology, has been elected an honorary member of the British Ornithologists' Union. Dr. Stone has been president of the American Ornithologists' Union and for twenty-one years he has edited the *Auk*, the official organ of the Union. Last year he was awarded the Otto Hermann medal of the Hungarian Ornithological Society (NATURE, 128, 670, Oct. 17, 1931). He has written a number of books on birds and other animals, and, with Cape May as a base for observations, has for many years carried on an intensive study of bird migration. Last year he completed, as editor, a revision of the "Check List of North American Birds", a monumental work in which is listed a description of every bird known to North America.

THE council of the Institution of Electrical Engineers has made the following awards for papers read during the session 1932–33, or accepted for publication: Institution premium to Mr. J. M. Kennedy and Miss D. M. Noakes; Ayrton premium to Mr. A. B. Read and Dr. J. W. T. Walsh; Fahie premium to Messrs. J. H. E. Baker and E. P. G. Wright; Kelvin premium to Mr. P. Dunsheath; Paris premium to Mr. W. S. Burge; Webber premium to Messrs. C. E. Horton and C. Crampton; Overseas premium to Mr. G. Yoganandam; Extra premiums to Messrs. J. C. Besly and H. V. Higgitt, Mr. Andrew R. Cooper, Mr. E. A. Hanney, Messrs. P. Hunter-Brown and C. J. Hews, Lieut.-Col. A. G. Lee, Lieut.-Col. F. A. Cortez Leigh, and Mr. R. P. Smith. The Wireless Section premiums have been awarded as follows: Duddell premium to Mr. E. C. S. Megaw; Extra premiums to Mr. L. B. Turner, Messrs. W. Ure, E. J. Grainger, and H. R. Cantelo. The following Meter and Instrument Section premiums have also been awarded: Silvanus Thompson premium to Mr. J. McG. Bruckshaw; extra premiums to Messrs. F. P. Burch and R. V. Whelpton, Messrs. C. Midworth and G. F. Tagg.

IN the leading article entitled "The Utilisation of Coal" discussing a symposium on this subject arranged by the British Science Guild, in NATURE of May 6, p. 633, disappointment was expressed that the authors of some of the contributions neglected to provide "the audience with complete comparative data from which the experts and laymen present could have drawn their own conclusions". Capt. Bernard Acworth informs us that the paper he was asked to read by the British Science Guild had as its title "The Economic Significance of Coal with Special Reference to Legislative Differentiation unfavourable to the Natural Expansion of the Coal and Coal Gas Industries". He deals fully, and accurately, with every aspect of the fuel economics of transport and power on land, sea, and in the air, in his recent book "Back to the Coal Standard".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant for abstracting work (chiefly engineering) at the Building Research Station, Garston (Department of Scientific and Industrial Research)—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (May 22). An assistant lecturer in engineering at the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (May 23). Two full-time teachers of engineering subjects at the Doncaster Technical College—The Secretary, Education Offices, Doncaster (May 23). A teacher in electrical engineering at the Technical Institute and Junior Technical School, Old Trafford, Manchester—The Principal (May 27). A head of the Department of Mechanical and Civil Engineering and a lecturer in geography at the Portsmouth Municipal College—The Registrar (May 27). A professor of mathematics at University College, Dundee (University of St. Andrews)—The Secretary and Registrar (May 31). A lecturer in biology at the Leicester College of Technology—The Registrar (May 31). An engineering assistant in the Engineering Department of the River Medway Catchment Board—The Engineer to the Board, 71A, Bank Street, Maidstone, Kent (May 31). An assistant lecturer in botany at the University of Birmingham—The Secretary, The University, Edmund Street, Birmingham (June 1). Visiting teachers in various branches of engineering, gas technology, mechanics and metallurgy at the School of Engineering and Navigation, High Street, Poplar, E.14—The Education Officer (T.1), County Hall, London, S.E.1 (June 7). A professor of dental surgery and director of the Dental Hospital at the University of Manchester—The Registrar (June 12). A reader (senior assistant) in pathology and a reader (senior assistant) in bacteriology in the Institute of Animal Pathology at the Royal Veterinary College—The Secretary, Royal Veterinary College, London, N.W.1 (June 30). A University lecturer in economics and politics at the University of Cambridge—Mr. E. A. G. Robinson, Sidney Sussex College, Cambridge. A woman lecturer in biology at the Lincoln Training College—The Principal. An organising secretary for the Association of Special Libraries and Information Bureaux—The Chairman of Council, ASLIB., 16 Russell Square, W.C.1. A technical assistant (Grade 3) for technical photography at the Royal Aircraft Establishment, Farnborough, Hants—The Chief Superintendent.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Beryllium and Helium

MANY years ago it was found that the mineral beryl often contains much more helium than can be accounted for by the traces of uranium and thorium which are present[1]. Recently returning to the subject, I have examined some thirty-five or forty beryls from different parts of the world and from different geological horizons. The richest of these contains 29·2 cubic mm. of helium per gram of beryl. The helium atoms number $2 \cdot 41 \times 10^{-4}$ of the beryllium atoms present.

If helium has accumulated in beryl as the result of atomic disintegration of beryllium, we should expect large helium content to be found only in the beryls of ancient formations. If on the other hand it has been trapped in some way when the mineral was formed, or if it is due to a short-lived radioactive product initially present in the mineral, we should expect to find large helium content in the younger beryls, since the opportunities for its escape have been less. The experimental results decidedly support the former alternative. Beryls from the younger rocks have not in any case been found to contain much helium. Beryls from the oldest formations usually contain a relatively large amount.

The probability that the main component of beryllium Be^9 is undergoing spontaneous disintegration is much increased by the recent measurements of Bainbridge with the mass-spectrograph[2]. He finds a value for the mass of Be^9 $9 \cdot 0155 \pm 0 \cdot 0006$, whereas the added masses of a hydrogen atom and two helium atoms amount to 9·01210. There is thus a considerable excess of energy available for spontaneous disintegration.

It was of interest to examine whether any α-ray activity was present adequate to account for the accumulated helium. The first experiments were made on the mineral itself, using the helium-rich specimen above mentioned. The walls of an electroscope casing were coated with it. The range of the α-particles was assumed to be 1 cm. in air, and the possible activity of the beryl was estimated from the ionisation at not more than $1 \cdot 47 \times 10^7$ α-particles per gram of mineral per annum. At this rate the helium observed would take more than $5 \cdot 43 \times 10^{10}$ years to accumulate.

Further experiments were made on a sheet of beryllium-aluminium foil (70 per cent Be) measuring 7·2 × 9·5 cm. which was kindly lent me by Mr. N. Feather, of the Cavendish Laboratory. The number of α-particles from this was estimated from the ionisation current at not more than $1 \cdot 55 \times 10^6$ per gram of beryllium per annum. At this rate the mineral would require more than $1 \cdot 05 \times 10^{11}$ years to grow the contained helium.

Either of these periods is much more than can be allowed; for the lead ratios of radioactive minerals never indicate an age of more than 2×10^9 years. Thus the helium in beryl cannot be brought into relation with any existing emission of α-particles. This conclusion, so far as it rests on experiments made with the mineral itself, does not depend on whether beryllium or some other constituent is thought to be the parent element.

It has recently been stated by Lange and Raitt[3] that beryllium has an α-ray activity of 1 cm. range and a 'half life' (half value period ?) of 10^{14} years. These authors consider that this is in striking accord with the presence of helium in beryls. But the ratio of helium atoms to beryllium atoms in the beryl above mentioned is $2 \cdot 41 \times 10^{-4}$, and this is the fraction of beryllium atoms transformed. If the half value period of beryllium were 10^{14} years, the time required would be $3 \cdot 5 \times 10^{10}$ years; about seventeen times as long as can be allowed.

While it appears certain that the small α-ray activity of beryllium found by Lange and Raitt will not account for the helium in beryl, the activity itself, if real, is of considerable independent interest. My own measurements with beryllium-aluminium foil led me to place the limit of possible activity three times lower, and I did not consider them as affording positive evidence of any activity. The calculation of emission from a thick layer is, however, not very satisfactory, and this may vitiate somewhat the comparison between the two sets of experiments. My own tests could have been pushed considerably further if enough of the foil had been available to line the electroscope casing completely. It is hoped to do this later.

RAYLEIGH.

Terling Place, Chelmsford.
May 8.

[1] *Proc. Roy. Soc.*, A, **80**, 589; 1908.
[2] *Phys. Rev.*, **43**, 367; 1933.
[3] *Phys. Rev.*, **43**, 585; 1933.

A Theory of Fuel-Knock

IN an essay written three years ago[1] it was suggested that fuel-knock in an automobile engine might be associated with the presence of free hydrogen formed from the fuel used, and at that time the following facts were advanced in support.

(*a*) That in the combination of hydrogen and oxygen, variation of partial pressures, temperature and initial pressure produces rates of reaction of completely different orders of magnitude[2,3,4].

(*b*) That hydrogen in an engine cylinder gives rise to violent fuel-knock[6], while a fuel which does not contain hydrogen, for example, carbon monoxide, is not known to knock[5].

(*c*) That fuels comprising stable molecules, both liquid (for example, benzene[7]) and gaseous (for example, methane[8]) are not known to knock, whereas those comprising unstable molecules (for example, kerosene) knock readily.

The liberation of hydrogen from hydrocarbons and/or their primary oxidation products has been reported even during slow combustion[8,9,10,11], and conditions in an engine cylinder (where the advancing flame compresses unburned fuel ahead) are suitable for the breaking up of fuel molecules with a consequent liberation of hydrogen. If it be assumed that fuel-knock be caused by the rate of reaction between this free hydrogen and the available oxygen reaching a high order of magnitude (due to a favourable combination of partial pressures and/or temperature), certain effects should be noticed. In a knocking engine it should be possible to eliminate the knock by the addition of small quantities of hydrogen (thereby taking the partial pressure of the hydrogen out of the critical range); it should be impossible to detect an intermediate stage in the formation of water vapour from the hydrogen (for example, OH molecules); and the temperature of the water vapour molecules formed in the knocking combustion should be considerably higher than in normal combustion. Evidence of these three effects has been forthcoming.

(1) In unpublished work performed at the Bureau of Standards early in 1921 it was found that the use of hydrogen in comparatively small amounts eliminated fuel-knock and the high pressures resulting therefrom.

(2) In a direct spectrographic comparison of the flames from knocking and normal combustion in an engine cylinder, OH bands in the ultra-violet disappeared from the knocking zone only when fuel-knock was present; in normal combustion they were detected throughout the cylinder[12].

(3) In work now proceeding at the Bureau of Standards on infra-red radiation from an engine cylinder (preliminary accounts of which have already appeared[13,14]) there are indications that the spectral distribution of the radiation during knocking and normal operation is essentially the same from the region where no knock occurs, while radiation from water vapour molecules on wave-lengths between 5μ and 10μ shows an increase when knocking conditions are compared with non-knocking in the region where knock occurs. The only change from knocking to non-knocking operation was the necessary variation in the proportion of benzole mixed with a fuel of low anti-knock value to eliminate the knock.

More complete data, and a discussion of this theory in its relation to existing theories of fuel-knock and knock-suppression will appear later, though it may be mentioned here that the combustion of hydrogen has been found to be remarkably inhibited by the presence of small amounts of anti-knock materials[15].

My thanks are due to Prof. S. Lees, from whom I obtained the original idea that hydrogen might be responsible for fuel-knock, and the acting director of the U.S. Bureau of Standards, for permission to publish this note.

SYDNEY STEELE.

Bureau of Standards,
Washington, D.C.
April 14.

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[1] Steele, John Winbolt Essay, University of Cambridge, 1930.

[2] Hinshelwood and Thompson, *Proc. Roy. Soc.*, A, **118**, 170; 1928.

[3] Gibson and Hinshelwood, *ibid.*, A, **119**, 591; 1928.

[4] Thompson and Hinshelwood, *ibid.*, A, **122**, 610; 1929.

[5] Burstall, *Proc. Inst. Auto. Eng.*, **21**, 628; 1926–1927.

[6] Burstall, *ibid.*, **22**, 358; 1927–1928.

[7] Sparrow, *Nat. Adv. Com. Aero., Tech. Rep.* No. 205, p. 19, 1925.

[8] Bone and Cain, *Trans. Chem. Soc.*, **71**, 26; 1897.

[9] Bone and Stockings, *ibid.*, **85**, 693; 1904.

[10] Bone and Wheeler, *ibid.*, **85**, 1637; 1904.

[11] Bone and Andrews, *ibid.*, **87**, 1232; 1905.

[12] Rassweiler and Withrow, *Ind. and Eng. Chem.*, **24**, 535; 1932.

[13] Steele, NATURE, **128**, 185, Aug. 1, 1931.

[14] Steele, *Ind. and Eng. Chem.*, **25** (Indus.), 388; 1933.

[15] Nagai, *Trans. Farad. Soc.*, **26**, 216; 1930.

Hydrocarbon Combustion in an Engine

AN outline of a theory of the behaviour of 'antiknocks', and of the character of the knocking type of explosion, was put forward in a lecture at the Royal Institution in 1928 (see supplement to NATURE of July 7, 1928). The ideas discussed were obtained by inference from a variety of experiments, rather than by direct demonstration. It was not demonstrated with any certitude, for example, that peroxides were formed during a knocking type of explosion in an engine cylinder; neither was it proved that the metallic 'antiknocks' were in an oxidised state before being effective as 'antiknocks' in the engine.

These and other points in agreement with the ideas then put forward have now been demonstrated, and, as then suggested, are of importance in connexion with the process of combustion of certain hydrocarbon vapours. By sampling the gases at various moments during the cycle of an internal combustion engine, by means of a special device which can be operated over a very small crank angle, the amounts of aldehydes and peroxides, etc., have been determined. Substances behaving as peroxides rise to a maximum, and then fall off in quantity prior to the passage of flame past the valve, whereas the aldehydes are at a maximum 1/240 second later, when the flame reaches the valve. The amount of 'peroxide' appears to be connected with the phenomenon of knocking. Benzene gave rise to no measurable peroxides, though aldehydes were present in considerable quantity.

It has also been demonstrated that thallium, which acts as an even more powerful 'antiknock' than lead, when let into the engine cylinder as vapour by a special valve, is only effective when previously oxidised.

It is intended to publish an account of these experiments on the completion of the investigation.

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F. LL. SMITH.

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Oxford.
May 10.

A New Type of Photoelectric Effect in Cuprous Oxide in a Magnetic Field

WHEN a plate immersed in liquid air and placed in a magnetic field parallel to its plane is illuminated by a beam of white light perpendicular to its plane, an electromotive force E is produced between A and B (Fig. 1). This electromotive force changes its sign when the magnetic field is reversed, its absolute value remaining unaltered. We investigated the dependence of E upon the intensity of the magnetic field H and found that up to fields of about 2,500 gauss, E is a linear function of H, the maximum electromotive force at this field strength reaching 2·7 volts. It may be noticed also that when the plate is illuminated from the opposite side, with the direction of the current in the electromagnet remaining unchanged, the electromotive force is reversed in sign. The existence of this electromotive force must evidently be looked upon as an indication of

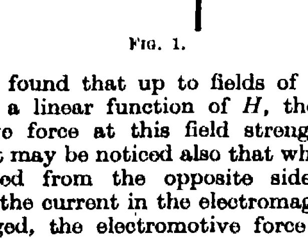

FIG. 1.

the fact that electric current is flowing perpendicularly to the plane of the plate. An examination of the sign of the electromotive force observed proves that the direction of the supposed flow of the negative electrons coincides with the direction of the light beam, assuming that under the influence of the magnetic field the electronic current is deflected in the normal way.

A characteristic feature of the effect may be noted, namely, that it disappears completely when a source of red light is used. The electromotive force is nearly independent of the intensity of light. We could not find the effect at room temperatures. The whole of the facts observed involve the assumption that the effect represents a peculiar Hall-effect of the moving photoelectrons produced at the entrance of the beam of light into the specimen. The proportionality between the electromotive force and the field strength gives strong evidence in favour of this supposition. This idea is supported, moreover, by the fact that the electromotive force is nearly independent of the light intensity. For example, the increase of the intensity of light augments the number of photoelectrons, which makes the Hall constant decrease (the Hall constant R is inversely proportional to the concentration of the conducting electrons). The observed electromotive force is a product of both effects. We are investigating the new effect further and we hope to publish shortly a complete account of this work.

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M. NOSKOV.

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March 31.

Elastic Electron Scattering in Gases

THE investigations by Arnot[1] and others of the scattering of electrons in gases show that marked diffraction minima occur in the angular scattering curves. Their measurements show also indications of an anomalous course of the velocity scattering curves. Still, as only the relative values of the scattering are determined, a comparison of the scattering through a constant angle for different electron velocities is subjected to incontrollable errors.

A method described by the writer[2] makes it possible to determine the absolute values of the scattered intensity I_θ – the total scattering being $2\pi \int I_\theta.\sin\theta.d\theta$. The results for elastic collisions in helium[3] for velocities between 30 volts and 400 volts and at angles $\theta = 45°$ and $90°$ show velocity scattering curves, which gradually converge towards the classical nuclear scattering at high velocities.

Recent measurements at $\theta = 45°$, $90°$ and $135°$ in neon and argon, however, have revealed marked anomalies in the velocity scattering curves. In Fig. 1 the value of the scattered intensity I_θ is plotted against the velocity (expressed in volts) of the electrons in a doubly logarithmic diagram, and the scattering through 90° observed in helium, neon and argon is shown as heavy lines. In this representation, the classical nuclear scattering curve $I_\theta = e^4Z^2/m^2v^4\sin^4\theta/2$ appears as a straight line. In Fig. 1 the dotted lines give the classical scattering for different values of the nuclear charge (Ze). It will be seen that at high velocities the scattering in all the gases, helium, neon and argon, converges towards the scattering of their nuclei, corresponding to $Z = 2$, 10 and 18 respectively. In neon, however, the scattering passes through a marked minimum at 90 volts, while in argon a discontinuity in the curve is found at about 250 volts.

While for high velocities the scattering in argon may be described as a scattering due to the total nuclear charge 18, the scattering at smaller velocities converges towards an effective nuclear charge of about 6. In scattering experiments with $\theta = 135°$, where the discontinuity in the argon curve is more marked, the scattering at smaller velocities follows the nuclear scattering curve for $Z = 5$, before converging towards $Z = 18$ at higher velocities. In the argon atom the outermost group of electrons consists of 8 electrons, and colliding electrons penetrating into this group will therefore be under the influence of an effective nuclear charge smaller than 8. If the velocity of the electrons is large, the electrons may penetrate through the outer group and the total nuclear charge 18 will determine the scattering. It seems as if this rough picture is to some degree justified by the measurements.

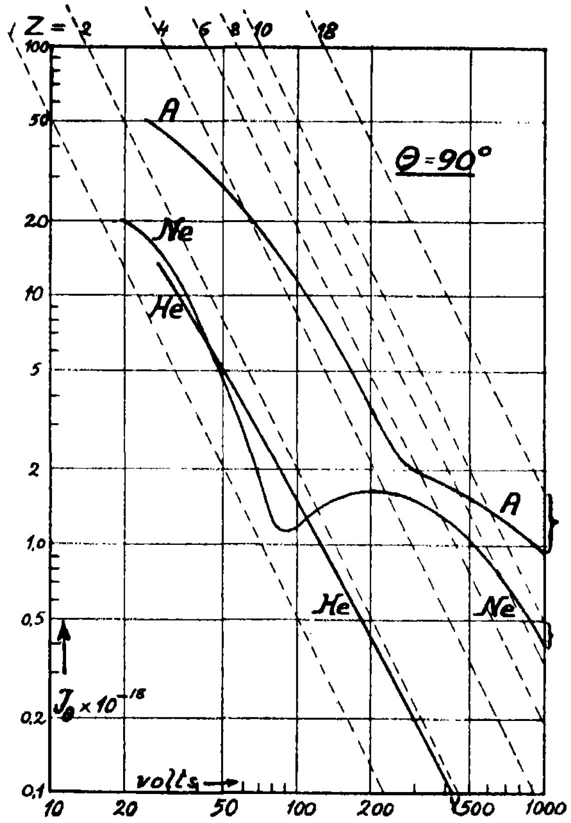

FIG. 1.

In neon the sharp minimum for velocities of about 90 volts allows of no such explanation and is probably due to some resonance effect of the same kind as that observed in the Ramsauer effect. The velocity (and potential) at which the minima or discontinuities are found changes with the scattering angle θ; as a rule they shift towards smaller values of the velocity when the angle θ increases. This may be connected with the fact that, according to the classical theory, the large angle scattering is due to electrons penetrating more deeply into the atom, and accordingly the total nuclear charge will govern the large angle scattering down to smaller velocities than the small angle scattering. At small angles, therefore, the scattering due to the total nuclear charge is first found at comparatively larger velocities. A closer explanation, however, of the anomalies observed will, of course, require a detailed quantum mechanical treatment.

SVEN WERNER.

Universitetets Institut for Teoretisk Fysik,
København.
April 11.

[1] *Proc. Roy. Soc.*, A, **133**, 615; 1931.
[2] *Proc. Roy. Soc.*, A, **134**, 202; 1931.
[3] *Proc. Roy. Soc.*, A, **139**, 113; 1933.

Ideas of 'Time' and 'Events'

1. Is 'time' conclusively or adequately defined by the statement that the 'time' of an 'event' in systems in motion varies according to the position of the 'observer' of the 'event'? This implies (1) that 'time' is a characteristic or property of, and is inherent in, an 'event'; and (2) that both 'time' and 'event' are functions, so to say, of an 'observer'. Therefore, if no 'observer' function, an 'event' cannot occur and the property 'time' is eliminated. If, however, an 'event' be more scientifically defined as an electromagnetic relationship between two bodies or points in space, it will occur whether observed or not (for not all bodies are observers) and 'time' is again eliminated. The question may therefore be asked: Is 'time' a characteristic of Nature or merely an idea of the observer? (See 4 and 5 below.)

2. The statement above is also incomplete in that it does not indicate how the 'time' of an *observed* 'event' is related to other events in the experience of the same observer (whether or not he be in the same position relatively to the whole system), nor how it is related to those events he has not observed but which he knows have taken place. If 'time' consist of cross-calculations of *moving* 'events' as amongst a *number of observers*, how can I or my children determine which of us arrived 'first' in this world of change? A human being has memories of past, and expectations of future, experiences; but his consciousness of the three 'tenses of time' does not depend on that of other observers in space. The sense of the 'lapse of time', of 'before and after', is peculiarly human and individual. My sense of change and the passing of time is independent of the fact that day dawns earlier for observers to the east. I should remember the past and anticipate the future were there no inhabitants beyond my own neighbourhood.

3. Further: although we record 'periods of time' according to solar and lunar phenomena, we have no standard 'constant' by which to measure human conceptions of duration, of 'lapses of time'. These vary not only with individuals but also with the individual's mental state; and a man may even become oblivious of 'time' in reverie or day-dreaming and in states of intense mental concentration, of meditation on principles, *not* passing events, just as does an artist intent on some creative work. The idle day-dreamer and the active genius lose their consciousness of personal relationship with objective physical events and come back to awareness of 'time' with a start. The genius, however, usually has something to reveal to time-bound mortals from those regions of the mind that are 'beyond time' although he may have difficulty in expounding it for our comprehension. It is commonly known, too, that 'time is long' for those in pain or remorse but that there is no consciousness of the 'lapse of time' in states of deepest joy and happiness. Hell is the perpetuation of 'time', heaven *its obliteration*! *'Time' is thus something* created entirely by ourselves; it is not a predicate conception, not something *a priori*. It is an individual affair, present or absent according to the molecular conditions of the frequency-levels in which the mind functions.

4. Is 'time', then, indeterminate, independent of moving events, an illusion of man? If a genius can annul 'time' in respect to the 'object' of *his* inner sense he must be able to distinguish between the *real being* of physically sensible objects and *our knowledge* of such objects as ordinarily assumed, stated or formulated by science. It is now admitted that *this knowledge, while dependent on, is limited by, the instrumental means of observation.* (For example, *vide* NATURE, March 25, pp. 422-3.) That is, we form an idea of the nature of an 'object' from the characteristics of the perceptible phenomena evoked by its invisible interactions with the measuring instruments; and this conception cannot, of course, represent, or be actually 'like', the *object itself.* This is true, also, even of those 'objects' which are reflected directly by our senses. But we have no warrant to conclude that there is no 'object' apart from our idea, that no 'object' exists independently of our observation by whatever means; for *neither we nor our instruments could have caused the sensible experience or the observed phenomena without a something with which to interact.* To deny the reality of the object's being is tantamount to denying that of the observer's! Nevertheless, it is claimed that 'time' is a *sine qua non* of any existence whatever, and there can be no 'matter' other than the physical mechanical motion of 'waves' or 'particles' because 'time' is relative and simultaneity impossible; and, consequently, that, beyond the perceptible physical, *nothing* exists that could function as, or constitute, an unthinkable absolute 'event' or 'standard time'. Thus 'events' close round human genius and shut it in a time-world of illusion, bound and blinded by the means of observation he has himself created. A spider caught in his own web!

5. Science has no evidence, however, that 'time' is a property of Nature, although the cosmos is doubtless in one sense a gigantic chronometer. What we with our limited powers of observation term the *past* and the *future* with respect to the universe or any particular cosmos, is potentially objective *now.* The universe *simply is.* The totality of its parts, frequency-levels and latent worlds or solar systems are a self-contained present. Otherwise, the recurring precipitation and condensation of *fundamental* types —stellar and terrestrial—would be impossible, unless, indeed, science can indicate how objectivity or manifestation could arise absolutely *ex nihil.* Discussions on simultaneity are irrelevant chimeras, for if the properties of bodies were absolutely identical they would be in the same 'place', as surely needs scarcely be said; that is, there would be no differences of 'potential' and no differentiated objective world. In that condition of space there can be no 'position', no location, no extension and no 'relativity'; but, as our ordinary human consciousness depends on concrete objective contrasts and has no experience of possible abstract subjective distinctions, we are unable to imagine or to describe in terms of present-

day scientific conceptions a state of self-subsistent spatial activity consisting throughout of uniform, synchronous pulsations or vibrations. Our only alternative is to try to explain scientifically, *without this 'hypothesis'* ; (1) how the universe coheres as one whole ; (2) how the cohesion of individual bodies is maintained ; (3) how different 'potentials' originate ; and (4) 'where' or in what kind of rare state of electrical accumulation that which manifests periodically is held in latency—including the *genius* of man.

W. W. L.

Light-Producing Powers of Sponges

IN his letter published in NATURE of February 18, p. 242, Dr. Crossland directs attention to the interesting fact that the most remarkable polychæte worm, *Syllis ramosa*, first discovered by the *Challenger* expedition at a depth of 140 fathoms, was found by him at a depth of only 1 fathom. Dr. Crossland describes how he obtained the worm from a siliceous sponge, stating that his method is the only way by which the bulk of the smaller fauna inhabiting coral reefs and sponges can be obtained. I have used another method with very satisfactory results.

Examining the list of light-producing animals, in which sponges are frequently mentioned, I observed at Villefranche sur Mer the surprising fact that different sponges living in the shallow waters were giving a very beautiful light. By accident I found one night a phosphorescent sponge of very fragile character ; breaking it and separating the two pieces very slowly from each other, I could see a number of very delicate shining threads stretching between the two pieces. I took some of these threads and brought them at once on a slide under the microscope. At the first glance I was able to identify the threads as branches belonging to a small phosphorescent annelid. Considering it probable that the animal, if short of water, would try to get again into its accustomed element, I poured the water out of the bowl, in which the 'light-producing' sponge was lying, and then attached the sponge to the edge of the inclined bowl in such a manner as to allow the water to drip slowly out of the sponge into the bowl. The next night I was amazed to see the abundance of small fauna assembled in the water, which had come out of the sponge, among it two little phosphorescent *Polycirrus aurantiacus* (Fig. 1), scarcely 5 mm. across, which were able to extend their branches to 40 mm. in all directions.

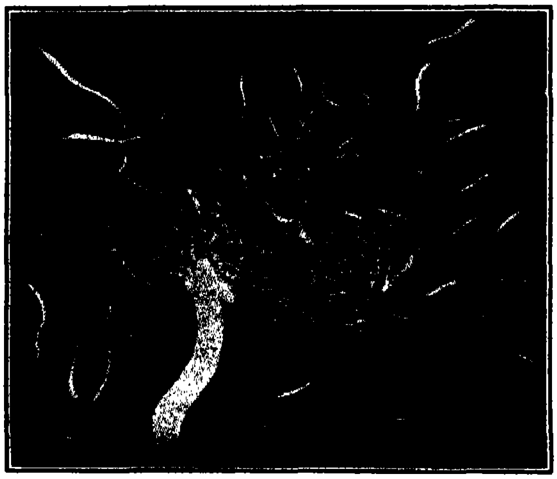

FIG. 1. *Polycirrus aurantiacus*.

I used the same method to get small animals out of different hiding places such as pieces of porous rock, etc., and could also fix particularly delicate animals, which often suffer under a narcotic, without damaging them.

The question whether the sponges are to be included among the light-producing animals has thus been decided.

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The Dodo and the Aphanapteryx

THE paragraph in NATURE of April 29, p. 615, on the Edwards dodo painting reminds one that this famous picture has a double interest. If one examines it as it hangs in the Bird Gallery of the Natural History Museum, one notes that behind the dodo is figured a long-billed bird referable to no known species of stork or ibis. The unknown is straight-beaked and of a reddish hue varied with black, feebly recalling the plumage of a corncrake ; it holds a frog in its bill. The occiput is slightly crested and the legs sturdy as if for swift running.

Now all these characters except the bill occur in the poulet rouge or aphanapteryx as figured by Hoefnagel in his book of drawings of the imperial menagerie at Ebersdorf about 1610. Hoefnagel's bird had the bill curved instead of straight, but this may be due to sex or maturity ; the length in both specimens is apparently the same. It seems probable that in the Edwards painting one sees the second known specimen of this long extinct creature, and like the first one drawn from life by a competent artist. This bird, like the dodo, inhabited the Mascarene Islands and a figure of it—long unrecognised—appeared in Strickland and Melville's volume on "The Dodo and its Kindred".

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Fusion of Pycniospores with Filamentous Hyphæ in the Pycnium of the White Pine Blister Rust

THE pycnia of the white pine blister rust are of the sub-corticular type as described by Arthur[1]. They may be characterised as extensive crust-like layers without definite delimitation and not having a well-defined ostiole and paraphyses such as are common to many of the leaf-inhabiting rusts. The pycnial crust consists of a dense layer of stromatic tissue formed by the anastomosing of the rust mycelium. From this layer arise the slender, erect, pycniosporophores, which are closely compacted in a palisade arrangement. Occasionally, a filamentous hypha is seen that projects for some distance beyond the common level reached by the sporophores and, although similar to them in structure, its diameter is usually greater and it is more irregular in outline. No cross walls have been observed in these hyphæ. A single nucleus is present, usually near the base. Often the tips of such hyphæ are bent over into a procumbent position due to the pressure of the overlying host cells. These hyphæ were first reported by Colley in 1918[2], who mentions their presence without comment.

For cytological study, fresh pycnia of the white pine blister rust were fertilised by interchanging the pycniospores, and, after a period of 48 hours, were fixed in Flemming's weaker solution together with an equal number of unfertilised pycnia of similar age. A copious exudate of nectar containing pycniospores was present on both sets of pycnia. Sections of both fertile and infertile pycnia were made as thin as 3 μ and stained with a modification of the triple stain. Both contained a few of the filamentous hyphæ described above, but in the fertile preparations eleven cases of pycniospores fusing with these hyphæ have been observed, while no case of fusion was found in the sterile preparations. These fusions are similar to the unions recently reported by Craigie[3] for the sunflower rust.

The pycniospores were united to the ends of the hyphæ by short tubes that were longer and of a somewhat smaller diameter than those illustrated by Craigie[3]. A few of the pycniospores seemed to be empty while others contained nuclei in the usual position. Actual migration of nuclei through the short connecting tubes has not been observed. Whether these tubes are extensions of the filamentous hyphæ or germ tubes sent out by the pycniospores remains to be established. A more detailed account covering the investigations undertaken on this subject will be presented at a later date.

School of Forestry, **ROYALE K. PIERSON.**
University of Idaho.
March 28.

[1] Arthur, C. J., "The Plant Rusts", 1–446, 1929.

[2] Colley, R. H., "Parasitism, Morphology, and Cytology of *Cronartium ribicola*", *J. Agric. Res.*, **15**, 619–659; 1918.

[3] Craigie, J. H., "Union of Pycniospores and Haploid Hyphæ in *Puccinia helianthi* Schw.", NATURE, **131**, 25, Jan. 7, 1933.

Lignin Content of Cellulose Products

IN the working out of a new method of determination of cellulose, especially suitable for cereal straws, we have recently had occasion to determine the lignin contents of cellulose products obtained by various means. Chlorinations, either gaseous or in solution (as our new method involves) were continued until there was no trace of a characteristic red colour on the subsequent addition of sodium sulphite. In spite of this, however, the lignin contents of the products from a number of straws were, in general, between 2·5 and 3·0 per cent.

The lignin determination depends on the resistance of lignin, first to cold 72 per cent sulphuric acid, and later to boiling with more dilute acid. Pure cellulose under such conditions yields only a trace of apparent lignin, no doubt due to slight charring or caramelisation. Starch and glucose similarly yield only a trace of apparent lignin. A pentose sugar, on the other hand, gave with this treatment an appreciable quantity of some material as resistant as lignin and determined as such in the accepted methods.

Natural celluloses from woods and straws are known to consist of 'true' cellulose associated with other polysaccharide material, known as 'cellulosans'[1]. It seemed possible, therefore, that the lignin found in straw celluloses might be apparent rather than real, and be in truth derived secondarily by the action of the sulphuric acid, on the 'cellulosan' or pentosan fraction of the natural cellulose. Accordingly, by mild hydrolysis with 5 per cent acid for 1 hour, this fraction was largely removed. The apparent lignin content of the residues fell by 25–30 per cent in every case, indicating the correctness of this view. However, the residual lignin contents were even then much greater than the figures obtained on most wood celluloses, and, moreover, could not be reduced by gross over-chlorination and repeated sulphite extractions. We are, therefore, of the opinion that, while a part of the apparent lignin content of celluloses from cereal straws is secondarily produced from the cellulosan fraction, there is nevertheless a portion of true lignin (or some other acid-resistant material) very tenaciously retained by the cellulose itself and possibly in combination. We shall investigate this point further in an attempt to characterise or extract this small residual fraction.

In view of this observation that apparent lignin may be formed from the pentose grouping, we consider that the whole question of the determination of lignin by the 72 per cent sulphuric acid method must be critically re-examined. The results usually given for straws and hardwoods will probably be found to be too high. Those for softwoods, in view of the smaller content of pentose material, are probably much more nearly accurate. By submitting straws to an acid pre-treatment (5 per cent sulphuric acid for 1 hour) before the determination of lignin and removing thereby the major part of the pentose material present both as polyuronide hemicellulose and as cellulosan, the apparent lignin content was lowered by 25 per cent or more. It seems likely that this lower figure is the true value.

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[1] Hawley and Norman, *Ind. and Eng. Chem.*, **24**, 1190; 1932.

Whale Shark in the Waters Around Ceylon

WITH reference to Dr. Gudger's letter[1] on the above subject, I am inclined to agree with the view which his last paragraph implicates, namely, that *Rhineodon typus* is a rare visitant to the waters around Ceylon.

During a residence of nearly twenty-three years in Ceylon, I have neither seen a whale shark nor have I heard of one having been washed ashore. It seems scarcely likely that this shark, with its great size and peculiar characters, could have escaped the notice of the fishermen.

This negative evidence, however, is not altogether convincing. I am reminded of the occurrence of whales in South Indian waters. After considerable experience of marine biological surveying in the seas around Ceylon, I should have been prepared to say that although whales are occasionally seen they are relatively rare and could certainly not be fished profitably for commercial purposes; yet a whaling expert, who came to Ceylon two years ago with the intention of establishing a whaling station in Ceylon, assured me that whales were more common than I had supposed and that commercial whaling off the coast of Ceylon could be carried on successfully.

It is possible, therefore, that the giant shark *Rhineodon typus* may be more common in South Indian waters than the small number of reliable records would lead us to believe.

JOSEPH PEARSON.

Colombo Museum, Ceylon.
March 7.

[1] NATURE, **131**, 165, Feb. 4, 1933.

Research Items

Stone Age Culture in Uganda. A stone age culture discovered at Magosi in Uganda has been described by Mr. E. J. Wayland and its affinities discussed by Mr. Miles C. Burkitt (*J. Roy. Anthrop. Inst.*, **42**, pt. 2). The site of the discovery is a platform at the base of a granitic rock on the west side of a saddle in bold hills. Excavation revealed an ancient water-cistern of natural origin, mainly filled with brick earth and lined with an 18-inch layer of rock-rubble. In this latter and above it was a zone rich in microliths. Below the rubble was rock-sand representing the disintegrated sides of the cistern. The depth of the archæological deposits was found to be 11 ft. There was no definite stratification, and no great change in culture throughout the deposits; except that the implements of the bottom levels were rather more primitive, and the middle levels were the richest in well-made tools. Two groups occur side by side: (1) pygmy cores and tools; (2) discs and points, the latter tending towards the Still Bay type of South Africa. In South Africa the two groups, the pygmy (Wilton), a neanthropic group, and the Still Bay culture are not found in association and are of different age. It has been proved that the Still Bay culture is the result of a contact between an African Middle Stone Age people and a neanthropic people; and this appears also to be true of Kenya. The Magosi pygmies are much more like the true Wilton of Kenya and South Africa than the pre-Wilton pygmies of upper palæolithic and Elmenteitan levels of Gamble's Cave. Yet in both areas Wilton appears definitely later than Still Bay; while the archaic appearance of the Magosi industry suggests that it belongs to an older age than the true Wilton. This is borne out by its association with a Still Bay industry. A further suggestion follows. Uganda may be an area in which took place a fusion between a Middle Stone Age people, who had developed the Still Bay point, and a neanthropic race, the fusion producing a proto-Wilton industry which migrated south and developed into the true Wilton.

Prehistoric Gold-Mining in South India. A communication from Mr. L. Munn, of the Hyderabad Geological Survey, records personal observations of an ancient gold-mine in Hyderabad. In sending these notes, Mr. Munn expresses a fear that much information gained by engineers during the last fifty years, but unrecorded, may be lost unless action is taken, and hopes that his notes may elicit further information. Beyond a report by Maclarren in the *Records* of the Geological Survey and the book by that author, Mr. Munn is unacquainted with any information on the subject. His own experience was gained at Hoonkoni in the Deodrug Taluq of the Raichur District. Here the old workings are a series of pits, 615 ft. in length, which, judging from the debris, yielded a panning value of 5–8 dwt. to the ton. The reef was worked as an open-cut to a depth averaging 20 ft. by fire-setting and breaking with stone hammers. This is evident from the amount of wood-ash encountered and the curiously concave section of the portion of the reef remaining. After about 20 ft., a ridge of solid ground, about 5 ft. thick, was left. It is thought that this was intended to prevent rock from falling from above, as well as to avert flooding of the lower levels by the monsoon rain-waters. At intervals in this rib, shafts were opened, and when the shafts were sufficiently far through, lateral excavations were made. Evidently hammer-stones were freely used. Working by fire-setting in a narrow shaft, with the object of leaving the rib of solid earth, tended to produce the ever-increasing flattened oval. There is no evidence for the use of any implement but stone; but iron instruments of indeterminate age have been found, though only just under ground-level. The narrow underground workings are closely packed with stones and mud. It is probable that this was done by the ancient miners for the purpose of concealment, timbering being employed to avoid the necessity of filling the whole stope. The conditions of working the mines must have been so trying, that it is improbable that any but forced labour was employed.

Winter Territory amongst Birds. In the "Calendar of Nature Topics" (Jan. 14, p. 69) it has been pointed out that the winter flocks of crowned sparrows (*Zonotrichia*) seem to keep within territorial boundaries. Observation of another species, the western robin of America (*Turdus migratorius propinquus*), suggests that within the flock there may be individual territory recognised as the exclusive feeding ground of a single bird. John B. Price bases this suggestion upon the movements of two western robins, easily recognisable because of abnormalities in plumage, for otherwise individuals are difficult to observe. These birds appeared to roost nightly with others of their species in enormous flocks (which may number thousands), but during the day they appeared consistently each on its own plot in the campus at Stanford University (*Condor*, 35, 52; 1933). One appeared daily (with three blanks) from January 19 until February 18, 1932; the other from February 12 until 18. The roost from which these daily visits were made was probably four or five miles away, and the regular appearance of the single birds at their own feeding ground (to which they returned before sunrise), their vigorous defence of their plots against new-comers (during a three-minute interval one was seen to join combat ten times) suggest that each western robin in a flock may have its own individual territory during the winter season.

A Virus Disease of Strawberries. The very descriptive name of 'yellow-edge' has been given to a new disease of strawberries ("The Strawberry 'Yellow-edge' Disease" by R. V. Harris, *J. Pomol. and Hort. Sci.*, 11, No. 1, 56–76, March, 1933). The disease is transmissible to healthy plants by grafting, and it is suggested that a virus is the causal agent. The symptoms are a general dwarfing and a malformation of the leaflets, which have chlorotic margins. Petioles lack the normal red pigmentation. Infected plants degenerate in vigour, bear no fruit and ultimately die. Symptoms are apparently masked during the warm period of summer. Control methods are discussed, and the possible identity of the disease with an American disease of strawberries known as 'xanthosis' is indicated.

Batholiths and Ore Deposits. In the *Journal of Geology* for 1933, Prof. W. H. Emmons presents a valuable summary of our present knowledge of the relations between batholiths and the metalliferous veins commonly associated with them. He shows that a normal batholith may be divided into (*a*) the metallised roof; (*b*) the metallised hood, which includes the ore-bearing margin of the igneous mass itself; and (*c*) the core, which is essentially barren of metals. It is believed that the magma of the batholith generated a strong vapour pressure on cooling and crystallising, after the manner illustrated by Morey's experiments on silicate melts. It is probable that this pressure was sufficient to shatter the roofs of some batholiths. Thus the magma may generate the forces responsible for the fractures that later become veins, as well as the metalliferous fluids from which the ores are deposited. The metals were expelled from the magma that formed the core after the hood had solidified. Deposition of ores is believed to have been accomplished before the solidification of the core was completed. Barren veins may form later in the core, but the batholith has now ceased to expel metals. The core appears to be no longer in communication with deep-seated sources of metals, presumably because of relatively early crystallisation at the roots of the batholith.

Flow of Water between Moving Boundaries. Cornish (*Proc. Roy. Soc.*, April) has investigated the flow of water between a revolving brass bush and a coaxial hollow cylinder. The clearance was of the order of 0·1 mm. When the flow was laminar, the resistance was unaffected by rotation at low speeds, but increased when the speed of rotation lay above a critical value. When the flow is turbulent the effect of rotation is found to diminish as the Reynolds' number increases. A set of curves is given which enable practical calculations to be made on flow through annular clearances of this type.

Semi-Conductors in a Magnetic Field. A quantum theory of conduction has been developed by A. H. Wilson (see NATURE, **130**, 913, Dec. 17, 1932). The energy spectrum of the electrons in an atomic lattice splits into a number of bands, which do not overlap in the case of an insulating crystal. If some of these bands are completely filled with electrons, transitions within the band are disallowed by Pauli's principle, and the energy of thermal agitation is insufficient to carry electrons into an upper band. The electrons cannot, therefore, acquire velocities in an electric field and the substance shows no conductivity. Atoms of a suitable impurity may have an energy state only a little below one of the upper unfilled bands, and these electrons may be transferred to the lattice by the effect of thermal agitation. The substance then behaves as a semi-conductor with a conductivity increasing with temperature. Since there are only a few electrons in this upper band, the electron gas is non-degenerate and may be treated by Maxwellian statistics. In a paper by J. W. Harding (*Proc. Roy. Soc.*, April) the effect of a transverse magnetic field on a conductor of this type is calculated. The electrons describe paths under the influence of the applied magnetic field, the applied electric field and the electric field produced by sideways transfer of electrons (Hall effect), together with the collisions with the lattice. An integral equation is set up expressing the condition that the distribution of electrons is steady under these forces. Solving this equation, the currents in different directions are calculated. Different methods are required for weak and for strong magnetic fields. The numerical results are in very reasonable agreement with the shape of the experimental curves for germanium in both strong and weak fields. The absolute value for the change of resistance is nearly right, and the variation with temperature is in the right direction. The Hall effect has not been measured for a semi-conductor but the variation with magnetic field predicted is similar to that observed for bismuth.

Inverse Sublimation. The December 1932 issue of the *Bulletin de la Classe des Sciences* of the Royal Academy of Belgium, which completes vol. 18, contains an interesting communication from M. Octave Dony. M. Dony describes the first of a series of experiments he has undertaken in order to investigate the laws which the crystallisation of a substance from a state of vapour appears to follow. Although this method of crystallisation is of great importance in industry, very little seems to be known as to the circumstances which influence the process. So far, M. Dony has experimented with phthalic anhydride and naphthaline, which were heated electrically in crucibles placed in large rectangular glass enclosures in one case low down, in another half-way up, and in a third near the top. The principal factor in determining the form of the crystals formed is found to be the intensity of the convection currents in the air of the enclosure. In the case of phthalic anhydride, the low position of the crucible tends to produce very long, thin, nearly parallel needles, the central position shorter crossed needles, and the high position very short needles scattered throughout light flocculent masses. There is also an optimum temperature for the crucible.

Radio Telephone Links. A large network of telephones in one part of the world is usually connected with networks in other parts by means of a radio transmission system called a radio telephone link. There are now more than fifty of these links but few of them are working to their full load capacity. The chief problem that has to be considered therefore is that of reducing operating costs. It is only on the few heavily loaded links that the expense of an improvement in the performance of the circuit would be justified. In a paper read to the Institution of Electrical Engineers on May 3, the advantages of using a single side-band system in short-wave telephone links are considered. The chief requirement of a radio-telephone link is that the average ratio of the speech signal to the interfering noises during the conversation must be as high as possible. It must be high enough to give easily intelligible speech over practically the whole period of the advertised service time. The chief advantage of the telephone is its immediate availability at any time required. Even breakdowns for a short period, although only occurring a few times a year, are quite serious. Atmospheric conditions and particularly those accompanying magnetic storms may put a link out of condition for one or two days. It is pointed out that to raise the ratio of the sound signal to the noise signal appreciably would help as the circuit could be kept in constant operation several hours longer although under bad conditions. With our present knowledge, it is impossible to avoid a complete 'fade-out' occasionally. The author gives a full technical discussion of the problem. In particular, he dwells on the many advantages of using short waves and applying the single side-band system to these links. He gives experimental results obtained between stations at Madrid and Paris which bear out his conclusions.

Pelvic Fins of the Lepidosiren

By G. E. H. Foxon, Department of Zoology, University of Glasgow

A REMARKABLE and unique feature of *Lepidosiren paradoxa* is the conversion of the pelvic fin of the male, during the breeding season, into a large gill-like organ. Much confusion exists both as regards the historical development of our knowledge of this phenomenon and also as regards its probable functional significance.

On March 10, 1894, Ehlers[1] pointed out that the pelvic fins of Lepidosiren are sexually dimorphic, those of the adult male being beset along their medio-dorsal surface with a thick growth of flattened papillæ arranged in bunches springing from a common base. Over the date March 20, 1894, Lankester[2] recorded and illustrated the same structures, and remarked that "whether tactile or respiratory they form a most remarkable feature". On June 19, 1894, Lankester[3] again figured the papillæ and, after examining them in microscopic section, suggested the possibility of their being erectile and of copulatory significance.

The discovery that the papillæ observed by Ehlers and Lankester are merely dormant rudiments which undergo active growth in relation to the breeding season was made by Prof. Graham Kerr on November 4, 1896; his diary referring to eight captured Lepidosirens contains the note, "Of these, two males appear to be assuming nuptial dress. The lateral papillæ which Lankester described are represented by branched filaments forming a thick fringe. Highly vascular and deep red in colour". On November 8 he recorded a female with rudimentary villi. A note written by Prof. Kerr during his stay in the Chaco but undated reads: "In many cases the fore limb is flattened and bears on its lower edge a series of flat papillary processes,—a rudimentary fringe. The fringe seems prominent in several males where fringe on hind limb: is there any connection between the two ?"

In his first paper on the Lepidosiren, Prof. Kerr[4] merely suggests that the fringes in question are nuptial developments comparable with those occurring not uncommonly in fishes and amphibians. In later papers, however, he shows himself more and more firmly convinced that the true physiological function of the filaments is as accessory organs of respiration, of special value to the male Lepidosiren which remains on guard over the eggs deposited in the burrow, as lessening the need of his temporarily leaving his charge unprotected in order to proceed to the surface to fill his lungs with air. Prof. Kerr indeed has a footnote to this effect in his first paper.

Agar[5] has added to our knowledge of these filaments and he was the first to describe those cases in which the pectoral fin shows similar developments to those of the pelvic fin. He also notes that the process of atrophy of the filaments coincides with the end of the period during which the male is guarding the young in the nest.

The possibility that the function of the filaments is connected with the emission of oxygen for the respiration of the eggs makes its first appearance in a paper by Budgett[6] published in August 1901. Budgett, who had been Prof. Graham Kerr's companion in the Chaco, and had intimate first-hand knowledge of the Lepidosiren and its habits, writes: "It is tempting to regard the vascular fringes on the pelvic limbs of *Lepidosiren* as in some way connected with the aeration of the eggs". Although mentioning the idea in print, Budgett with his practical knowledge did not adhere to it, but concluded that, "it seems more probable that the fringes are as Kerr holds, accessory organs of respiration".

Mr. J. T. Cunningham[7] in 1912 repeats Budgett's earlier suggestion: "it would seem more probable that the use of the filaments in the Lepidosiren is to provide for the respiration, not of the parent himself, but of the ova".

Dr. Carter and Mr. Beadle[8] in carrying out their investigations in the Chaco developed quite independently a distinct leaning towards the emissive significance of the filaments. The revival of interest in the 'emissive' hypothesis is due to the publication of two papers, by Cunningham[9] and by Cunningham and Reid[10] respectively. The first of these is mostly speculative and will not be referred to further, except to note that the statement that the filaments arise from the ventral side of the fin, instead of as described by Ehlers, Lankester and Graham Kerr, is incorrect. In the second paper, however, Mr. Cunningham and Mr. Reid support the emissive hypothesis by actual observations carried out on the Island of Marajo.

Before proceeding to indicate why the experiments of Cunningham and Reid are insufficient to prove that the function of the pelvic filaments is to emit oxygen, it will be as well to summarise why the probabilities lie in the opposite direction, that is, that under natural conditions the filaments are concerned with the respiration of the parent.

The nests lie at the bottom of the swamp; they are very variable in size, but generally extend for several feet horizontally, being about nine inches to one foot in diameter. The eggs are scattered at random in a single layer over the floor of the burrow, and it may be pointed out that the smooth surface of the egg-shells makes it physically impossible for them to be piled up in a heap round which the parent could lie coiled up. The suggestion that the filaments emit oxygen in the immediate neighbourhood of a pile of eggs or a mass of larvæ is not, therefore, consistent with the facts; and to raise the oxygen content of the water sufficiently to be of use to the developing young it would have to be raised throughout the burrow. In a burrow 2 ft. 6 in. long with a diameter of 9 in. the oxygen content of approximately 31 litres of water would have to be raised.

The nest lying at the bottom of the swamp, any breathing on the part of the male would, as Budgett pointed out, necessitate a journey through several feet of water to the surface. The male guards the nest, frequent absences would give opportunities for enemies to enter and make a meal off the eggs or young larvæ, and frequent coming and going would only serve to attract attention to the presence of the nest. Again, the vascular filaments themselves would be a juicy morsel for any enemy, and if they were lost in this manner, severe and probably fatal bleeding would result. Repeated excursions to the surface such as would have to be made if the male were in any way a means of supplying oxygen to the young, would be seriously detrimental to the welfare both of the male and to the offspring. It is entirely reasonable, therefore, to regard the filaments as a means of diminishing the need of frequent absences from the nest.

The positive evidence adduced by Cunningham and Reid in support of the 'emissive' function is merely that in certain cases the amount of oxygen in water of low oxygen content is increased when a Lepidosiren with pelvic filaments is placed in it. That this is so is only to be expected, seeing that the fish had access to the air and were allowed to breathe at intervals throughout the experiments. It would be more remarkable if the oxygen content of the water did not rise, for Mr. Cunningham[9] himself has shown that in de-oxygenated water goldfish, perch and axolotls all allowed measurable quantities of oxygen to leak away. That oxygen is not given off by female Lepidosirens or by immature males is no doubt due to the epidermis not being thin enough to allow such diffusion to take place—even the gills are too thick (Fullarton[11])—while on the other hand the breeding male, in the pelvic filaments, possesses an organ through which such diffusion can take place. If a male Lepidosiren, with filaments, is submerged in de-oxygenated water but is allowed to keep up the oxygen tension in its blood by breathing air into its lungs, a rise in the oxygen content of the water is only what is to be expected.

Before reliable conclusions can be reached, information must be sought as to what happens when males with filaments are denied access to atmospheric oxygen. Prof. Graham Kerr found that Lepidosirens, if prevented from breathing air, quickly die; an instructive and perhaps conclusive experiment could be performed if the times taken by ordinary male Lepidosirens to drown were compared with those taken by males with filaments. If the 'emissive' hypothesis is correct then the breeding males must die more quickly than the others.

Finally, it should be borne in mind that in all cases where oxygen is actually excreted from the blood, as in the air-bladders of certain fish, glands for that purpose are present; in the Lepidosiren no such structural modifications have been described.

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[1] *Nachr. Ges. Wiss. Göttingen*, Nr. 2; 1894.
[2] NATURE, **49**, 555, April 12, 1894.
[3] *Trans. Zool. Soc. Lond.*, **14**; 1898.
[4] *Phil. Trans.*, **192**; 1900.
[5] *Anat. Anz.*, **33**; 1908.
[6] *Trans. Zool. Soc. Lond.*, **16**, pt. 2, No. 5; 1901.
[7] "Animal Life", Gen. Ed. W. P. Pycraft. "Reptiles, Amphibia, Fishes and Lower Chordata", Ed. J. T. Cunningham, *London*; 1912.
[8] *J. Linn. Soc. Zool.*, **37**; 1930.
[9] *Proc. Roy. Soc.*, B, **105**; 1929.
[10] *Proc. Roy. Soc.*, B, **110**; 1932.
[11] *Proc. Zool. Soc. Lond.*, pt. 4; 1931.

Metals and Man*

THE first annual Research and Development lecture arranged by the British Science Guild was delivered, on May 16, in the hall of the Carpenters' Company, London, by Sir Harold Carpenter, his subject being "Metals in the Service of Human Life and Industry". Lord Melchett, who presided, said that the lecture had been instituted to direct attention to the importance of research—both purely scientific and technical—and the utilisation of its results for the benefit of mankind. The British Science Guild desired the lecture to be associated with the name of Sir Richard Gregory, who as Editor of NATURE, and in other activities, had done so much to secure increased recognition of the services rendered by science and scientific workers to progressive life.

Sir Harold Carpenter began his lecture by pointing out that, of the products of the physical universe which have contributed most to the comfort of the human race and the industrial progress of the world, metals are entitled to the first place. Man's most striking achievements have depended largely on the use of metals, as indicated by ships, bridges, railways, automobiles, power stations, aeroplanes, telegraph and telephone systems and broadcasting.

Leaving agriculture and fishing out of consideration, the beginning of metallurgy was the beginning of industry and also the beginning of civilisation. The material achievements of metallurgy constitute only a portion of its service to mankind, as it was in the practice of this art that man developed mental attributes which led to the foundation of science and modern thought. From the practice of this art men acquired the mental habit of inquiring into the phenomena observed in order to attain control over them and thus over Nature also. Chemistry developed from the old art of metallurgy, but engineering did not do so; yet in recent years the engineering, chemical, and metallurgical industries have reacted on each other in innumerable ways.

The core of the earth probably consists mainly of an alloy of iron and nickel, but the crust is of an entirely different composition. This crust has resulted from the gradual solidification of the earth from the state of a molten ball. During this solidification a sorting out of constituents has taken place, resulting in a layer of silicates on the surface containing originally very little metal, but during further cooling a differentiation of the constituents has taken place resulting in the separation of silicates and sulphides and the concentration of metals in certain parts.

The calculated composition of the accessible crust indicates that, of the metals, only aluminium and iron are present in appreciable amounts, and that all other metals taken together amount to less than half of one per cent. If these metals were uniformly distributed, metallurgy would not exist. The concentration of the metals in workable deposits in relation to concentration in the earth's crust varies from 4 to 5 times in the case of aluminium, to 4,000 to 15,000 times in the case of silver.

From the point of view of the rise and development of the metal arts from the earliest times, the industrial history of mankind may be divided into two major epochs—a stone age and a metal age. Between these there was a transitional period in which the metals, as found in their native state, were used as stones. The definite establishment of a metal age was due mainly to the discovery of the possibility of smelting metals from stones, and the importance of this discovery comes in the same category as the first method of producing fire artificially.

The metals gold and copper were the first to be used by man, and both were obtained from native metals. From the mere melting of a native metal to the smelting of an ore was a great advance, and this discovery was, in all probability, the result of an accident at the edge of a camp fire. The observation by the early workers that copper, as obtained from different deposits, had different properties, led to the mixing of other materials with the copper ore being smelted and ultimately to the production of bronze. It is generally recognised that so early as 3000 B.C., the Egyptians were skilled in the smelting and casting of copper, but the earliest authentic bronzes date from about 1600 B.C.

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* "Metals in the Service of Human Life and Industry". Pp. 39. British Science Guild, 6, John Street, Adelphi, W.C.2. 1s., including postage, 1s. 1*d*.

The next important discovery was the production of iron, and it is generally agreed that iron did not come into general use in Egypt until 1300 B.C., which may be taken as the beginning of the iron age. It appears that the Egyptians were acquainted with the carburising process for converting iron into steel about 1200 B.C., and with the quenching process for hardening steel about 900 B.C. After this, no important metallurgical discovery appears to have been made for a long time. Brass was first made at the beginning of the Christian era, and the next discovery of prime importance was that of cast iron, which was first made in the fourteenth century. This discovery was the outcome of the gradually increasing size of the furnaces used for making direct iron. The smelting of iron ores in large furnaces with the use of coke began early in the eighteenth century and marks the beginning of the modern iron and steel industry.

The next discovery of importance was the making of crucible steel at the end of the eighteenth century, but steel did not become available in large quantities until the invention of the Bessemer process in 1856. During the last seventy-five years the development has been rapid and during the past thirty years more metal has been used than in all previous time.

Sir Harold Carpenter traced the progress of casting metal from the first castings in stone moulds to the modern methods of centrifugal and pressure die castings. The properties of metals, including strength, ductility and malleability received attention, and the chemical properties, especially as regards their resistance to the chemical action of their environment during service, that is, corrosion, were shown to be of the highest importance.

The effects of science on metallurgy have been most marked and important. So recently as just over a century ago, changes in metallurgical practice were mainly the result of chance discoveries or the consequence of a reaction to changing economic conditions. Scientific attention began to be directed to the systematic search for new alloys, new methods of mechanical and heat treatment, more economical methods of manufacture, better plant and greater reliability of product. The most conspicuous illustration of the influence of science on metallurgy is found in the case of aluminium. It is the most plentifully occurring metal in the earth's crust and yet has become available only within living memory. To-day, iron and aluminium are the two most important metals, iron having been used by man for over three thousand years and aluminium for under fifty years. The application of the methods of science to the ancient art of metallurgy, and the increased knowledge gained thereby, will contribute ever increasingly to the amenities of human life and the progress of art and industry.

Spectra of the Planets

THE annual George Darwin lecture was delivered at the Royal Astronomical Society's meeting on May 12; the lecturer being Prof. V. M. Slipher, director of the Lowell Observatory. He chose as his subject the spectra of the planets, the study of which has been, from the first, an important feature in the work of the Lowell Observatory. He noted that the advent of the spectroscope made it possible to learn something about the chemical composition of other worlds, and gave a sketch of the early work carried out by Sir William Huggins, using visual methods.

The introduction of photographic methods made a great advance possible; when the method was first used, the plates employed were insensitive to red light, and the infra-red region was quite excluded. Of late, the makers of plates have triumphed over these difficulties, and a great extent of the infra-red spectrum can now be photographed. This is specially important in planetary work, as there are many interesting lines and bands in this region.

An initial difficulty is that of separating planetary lines from those due to the terrestrial atmosphere. Prof. Slipher described different methods of discrimination; comparing a planet with the moon at the same altitude, or comparing the planet's spectrum at high and low altitudes. Also the terrestrial lines can be weakened by going to a high station. Some photographs have been taken at the San Francisco Peak, 11,000 ft. high, which is near the Observatory.

Another method, needing considerable dispersion, makes use of the shift of the planetary lines due to radial motion. This has been applied to Venus, with the result that oxygen cannot be traced in its spectrum, but carbon dioxide is suspected. Great endeavours were made to test the rotation of Venus by the spectroscope. The slit was placed in various position angles, also with the spectroscope in two opposite positions, 180° apart; the plates were shuffled, and the measurer kept in ignorance of the conditions of exposure, to prevent any possible bias. Unfortunately, no positive result was reached, but Prof. Slipher considers that ten days might be named as a lower limit to the planet's period of rotation.

Some twenty-five years ago there was a controversy as to the presence of the *a* band, due to water vapour, in the spectrum of Mars. Lowell's book on the planet, published in 1909, included a reproduction of spectra taken by Prof. Slipher in 1908, showing the *a* band stronger in the Martian spectrum than in the lunar one. Some doubt was thrown on this by other observers, but the presence of a small amount of water vapour is now generally accepted.

Prof. Slipher then proceeded to discuss the four giant planets; their spectra resemble each other in showing series of conspicuous bands, which increase in strength as we go from Jupiter to Neptune. Spectrograms of Jupiter were shown, which exhibited bands far in the infra-red, to wave-length 10,000, but 8,600 was the limit reached in the case of Uranus and Neptune. The origin of most of these bands is still unknown, but lines due to ammonia have lately been identified in the spectrum of Jupiter; a slide was shown in which they were visible. It is appropriate finding ammonia in Jupiter, as the name is taken from the temple of Jupiter Ammon in Africa, which appears to have been the earliest source of supply of this substance.

Allusion was next made to the determination of the period of rotation of Uranus by spectrograms taken at the Lowell Observatory in 1911. The equivalent focus used was 55 ft., and the usual precaution was taken of rotating the spectrograph through 180°, between two series of exposures. The deduced time of rotation was 10·7 hours. Some attempts are being made to see if Pluto shows any periodic variation of light, from which its rotation time can be deduced; but there is nothing as yet to report.

The suggestion, now generally accepted, that the stationary calcium lines in certain stellar spectra are due to light-absorption in interstellar space, not in the stars themselves, was made at the Lowell Observatory in 1909. Prof. Slipher spoke of some faint lines that were photographed on the dark side of Venus, but he is inclined to ascribe them to our own atmosphere. He expressed the opinion that there is a faint permanent aurora present in the atmosphere, and showed some plates taken with long exposures, on which the auroral lines could be traced.

At the conclusion of the lecture, the president, Prof. F. J. M. Stratton, presented the gold medal awarded by the Council to Prof. Slipher for his spectroscopic work on planets and nebulæ. He said that the lecture itself sufficiently established the grounds for the award, and dispensed with the necessity of a presidential address on the subject.

A. C. D. C.

The 'Catkin' Radio Valve

WITH the rapid growth in broadcast reception, the general public has become used to frequent changes in the types and design of receiving valves. These new types have usually been aimed at giving improved performance under modern conditions of radio communication, and in the past, they have invariably appeared in the familiar glass bulb form. A radically different type of construction is adopted in the 'Catkin' valve, which was placed on the market on May 18, by the General Electric Co., Ltd. and the Marconiphone Co., Ltd. This new valve is really a small model of the high-power type of 'Cooled-Anode-Transmitting' (C.A.T.) valve which was produced for wireless transmitting stations a few years ago.

In the new construction shown in the accompanying sectional diagram (Fig. 1), the amount of glass-work, with its fragility and dielectric losses, has been reduced to a minimum. The upper portion of the envelope is formed of the cylindrical copper anode which is sealed to the lower glass portion by a vacuum-tight joint. The other electrodes are rigidly mounted inside this envelope, using mica spacing and insulating pieces where necessary. In the glass type of valve the electrode system is usually carried in the glass 'pinch' near the base, an arrangement which makes it difficult to ensure definite location and gives rise to considerable dielectric losses in some valve circuits. In the new construction, the lower ends of the electrodes are held rigidly in a suitable steel clamp with mica insulation, and the leads are brought out through the glass ring at the base, being well spaced around its circumference. This arrangement makes it possible to obtain much greater precision in the electrode dimensions and spacing in manufacture, so that the mass-produced valves should conform much more accurately to a uniform performance than was possible hitherto.

The glass ring forming the lower portion of the envelope is supported in its base by a rubber clamp, which acts as an efficient sound insulator, thus reducing the susceptibility of the valve to microphonic effects. The much smaller diameter of the anode also results in comparative freedom from response to sound vibrations transmitted through the air, which sometimes form a source of trouble with glass valves.

Screen-grid and detector valves are, nowadays, usually metallised in order to avoid the effects of strong electric fields set up by charges on the glass envelope. The electric field within the anode of the Catkin valve is entirely uninfluenced by any surrounding charges. If further screening is required in order to reduce stray coupling to the anode itself, an octagonal tubular metal cover is provided fitting over the entire valve. In this form the valve is remarkably strong mechanically and its overall *dimensions, including the standard four- or five-pin* cap, are about 5 in. by 1⅛ in. diameter.

Output valves do not require this outer screening cover, and in this case the exposed anode is given a coating of black enamel insulation. In all cases, since the anode is exposed directly to the air, liberal heat-dissipation is provided and the electrode system as a whole runs at a lower temperature, thus reducing the liability of the valve to soften due to the release of gases occluded on the inner walls of the envelope.

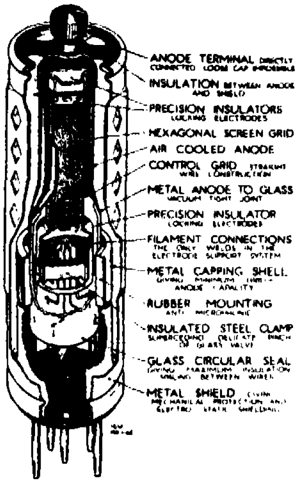

ANODE TERMINAL DIRECTLY CONNECTED
INSULATION BETWEEN ANODE AND SHIELD
PRECISION INSULATORS LOCKING ELECTRODES
HEXAGONAL SCREEN GRID
AIR COOLED ANODE
CONTROL GRID STRAIGHT WIRE CONSTRUCTION
METAL ANODE TO GLASS VACUUM TIGHT JOINT
PRECISION INSULATOR LOCKING ELECTRODES
FILAMENT CONNECTIONS THE ONLY WELDS IN THE ELECTRODE SUPPORT SYSTEM
METAL CAPPING SHELL GIVING MINIMUM ANODE CAPACITY
RUBBER MOUNTING ANTI MICROPHONIC
INSULATED STEEL CLAMP SUPERCEDING DELICATE PINCH OF GLASS VALVE
GLASS CIRCULAR SEAL GIVING MAXIMUM INSULATION BETWEEN WIRES
METAL SHIELD GIVING MECHANICAL PROTECTION AND ELECTRO STATIC SHIELDING

FIG. 1.

The Catkin valve is at present being supplied in four types, the constants of which are similar to those of the corresponding glass valves, so that they are interchangeable with those in use in present-day receivers.

University and Educational Intelligence

BIRMINGHAM.—Shortly after the death of Prof. John Henry Poynting in 1914 a fund was subscribed by his friends with the object of providing a memorial to him. Part of the money thus raised was used for the publication (by the Cambridge University Press) of a volume of his "Collected Scientific Papers", of which a copy was presented to every university in the British Empire and to representative universities in foreign countries. Another part of the fund was used for the purchase of a portrait to be presented to the University of Birmingham and hung in the great hall of the University. The remainder, which was invested, together with the accrued interest, has been offered to, and accepted by, the Council of the University, for the foundation of a Poynting lecture, to be delivered at intervals of not more than two years by physicists of outstanding distinction.

CAMBRIDGE.—The Adams prize for 1931–32 has been awarded to A. H. Wilson, research fellow of Emmanuel College.

The managers of the Balfour Fund have made grants of £50 to Mr. C. Forster-Cooper, of Trinity Hall, for researches on the fauna of the Achenarass quarries and to I. T. Sanderson, of Trinity College, for researches on the vertebrate fauna of the Cameroons.

It is recommended by the General Board that a readership in physiology be established with a pensionable stipend of £850, and that the first holder of the readership be Dr. F. R. Winton, of Clare College, at present University lecturer in physiology.

It is recommended that an additional University lectureship and an additional University demonstratorship be established in the Department of Anatomy.

The degree of Sc.D., *honoris causa*, is to be conferred on the Marchese G. Marconi, and on Sir Frederick Gowland Hopkins, Trinity College, Sir William Dunn professor of biochemistry.

At Clare College, H. McC. Taylor has been elected to a research fellowship. Mr. Taylor was a wrangler (*B**) in the Mathematical Tripos Part II, 1930 and was elected to a Smith's prize and to an Allen scholarship in March 1932.

SHEFFIELD.—At a meeting of the Council, held on May 12, the following appointments were made: Dr. G. A. Clark, at present lecturer in physiology, to the chair of physiology, in succession to Prof. J. B. Leathes; Mr. W. R. Maddocks, as lecturer in metallurgy; Mr. J. Dick, as assistant lecturer in mechanical engineering; Mr. A. J. Macdougall, as assistant lecturer in metallurgy.

WALES.—Dr. W. R. Ivimey-Cook has been appointed assistant lecturer and demonstrator in botany in University College, Cardiff.

The University of London's activities during 1932–33, as reviewed in the Principal's report, presented on May 10, showed steady progress despite the necessity laid upon it in common with all other institutions in the country of exercising the utmost care in husbanding its resources. The Bloomsbury site figures prominently in the report. The general design for the whole site was completed by the architect, Mr. Holden, and exhibited in the form of a sketch model. Building is to begin at the southern end, next to the British Museum, the material employed being Portland stone with a brick core. The foundation stone is to be laid on June 26 by H.M. the King. In this connexion an outstanding event of the year was the gift of £100,000 by the Corporation of the City of London towards the cost of a new Ceremonial Hall, and this gift was followed by others toward the same purpose by many other City companies, the aggregate total to date being £166,000. In a long list of other important benefactions, including £48,000 from the Rockefeller Foundation for the endowment of clinical research in connexion with University College Hospital and the Medical School, an interesting item is the gift by the editor and proprietor, Dr. William Page, of the copyright and material of the "Victoria County History" of which ninety-one volumes have already been issued and as many more are projected. The Pilgrim Trust has granted the University £1,500 towards the cost of completion. The total admissions to the University in 1932–33 were 11,891 as compared with 6,295 in the first year after the War and 11,018 in 1931. The roll of internal students comprises 12,219 names, an increase of 529 compared with the preceding year, while those registered as external students have been steadily maintained at about 13,000.

AMONG the awards of Commonwealth Fund fellowships tenable by British graduates in American universities for the two years beginning September 1933 are the following: Mr. J. W. L. Adams (Oxford) to the University of Chicago, in economics; Mr. J. F. Danielli (University College, London) to Princeton University, in Chemistry; Mr. J. E. Harris (London and Cambridge) to Columbia University, in zoology; Mr. S. H. Jones (Swansea) to Johns Hopkins University, in geology; Mr. B. B. Kinsey (Cambridge) to the University of California, in physics; Dr. J. H. Lamble (Liverpool) to the University of Michigan, in engineering; Dr. Andrew McLean (Edinburgh) to the University of Illinois, in chemistry; Mr. C. E. Marshall (Durham) to the University of Pittsburg, in geology; Mr. H. S. A. Potter (Oxford) to Princeton University, in mathematics; Mr. E. A. Radice (Oxford) to Columbia University, in economics; Dr. H. C. Rowan (Birmingham) to the Massachusetts Institute of Technology, in engineering; Dr. J. C. E. Simpson (Liverpool) to the Rockefeller Institute, in chemistry; Miss P. M. Skinner (Cambridge) to the University of Wisconsin, in mathematics; Mr. R. H. Stoy (Cambridge) to the University of California, in solar physics; Mr. I. W. Tervet (Glasgow) to the University of Minnesota, in botany; Mr. E. L. Trist (Cambridge) to Yale University, in psychology. Mr. G. G. Cillié (Stellenbosch and Oxford) has been awarded a Dominion fellowship, for astrophysics, and will go to Harvard University. The following have been appointed to fellowships tenable by candidates holding appointments in government service overseas: Dr. C. M. Focken (Melbourne and Oxford), of the Department of Education, Government of New Zealand, to the Colorado School of Mines, in engineering; Dr. H. W. Mulligan (Aberdeen), of the Indian Medical Service, to the University of Chicago, in medicine; Mr. R. McI. Tyndale-Briscoe (Cambridge), of the Department of Mines and Public Works, Government of Southern Rhodesia, to Harvard University, in geology.

Calendar of Nature Topics

Weeds

The unceasing battle against weeds has now reached the spring phase, when the innumerable seedlings breaking through the newly-drilled cornfields and root breaks are receiving special attention. The aim is to disturb and weaken as many weeds as possible in the hope that the crop will master the remainder. Light harrows are used, and, even if some corn is uprooted or potato sprouts knocked off, the loss is more than compensated by the cleaner crop. In the corn crops little further is done, for horse-hoeing between the narrow rows of cereals, one of the most skilled and exacting jobs of the agricultural worker, is now seldom practised. In roots, the struggle continues until the plants meet in the rows.

Although hoes and harrows have been increased in size and improved in design, no alternative to the mechanical treatment of weeds is yet in general use. Two new methods of approach have been tried and are making headway. The best known consists in spraying the weeds in the standing crop of corn with corrosive solutions or dusts. The success of these methods depends on the fact that the upright, waxy leaves of the corn are much less damaged than the flat leaves of the infesting weeds. Another possibility is the use of stronger doses of more toxic compounds when the ground is unoccupied by a crop. The problem here is to discover a substance that is cheap enough to use on an acre scale. It must also decompose in the soil to leave the land fit to be cropped at the proper time.

The extension and perfecting of weed control by chemical means is highly desirable, but it must not be overlooked that certain indirect benefits accrue to the cultivator by his mechanical efforts against weeds. The soil is maintained in a well-aerated and crumbly condition, the loss of water is reduced, and active production of nitrates is encouraged. The value of these conditions is difficult to assess, but something would have to be done to attain them in any event. The farmer's best ally in his cleaning operations is a dry season. The extraordinary summers of 1911 and 1921 enabled some of the most obstinate land to be set in order. But success is never complete; dormant weed seeds resist all efforts to make them germinate, and survive to open a fresh attack at some later season.

Kangaroo Mouse of Western America

In the high grounds of Nevada, Oregon and California, at an altitude of 4,000–6,000 ft., lives "one of the most remarkable of the many new and interesting mammals that have been discovered in North America during the past few years", the kangaroo mouse (*Microdipodops megacephalus*). Probably the newly born young have never been seen in the nest, but the discovery of pregnant females in Nevada by E. Raymond Hall and Jean M. Linsdale showed that the breeding season reached its climax in May and early June and tailed off in July. The young are relatively large at birth and number one to six in a litter (*J. Mammalogy*, 10, 298; 1929). The mice, six inches in length, progress rapidly by hopping along on their hind feet, and so great is the power and accuracy of their jumping that a young individual repeatedly leapt out of a can, ten inches in diameter and seventeen inches high, without touching the sides of the can. During the day, kangaroo mice live in burrows excavated in fine sand, and the entrances to these they appear to block with sand when they enter them in the morning, so that they become invisible. Whenever an open burrow was discovered it was empty. The habit of living in loose fine sand results in spotted distribution where the type of soil varies markedly, and the distribution is further restricted because of the need of plants yielding the seeds which probably form the main part of the diet of the mice.

Phæocystis and Herrings

Usually in May the sea becomes a brownish-green colour in patches owing to the presence of the colonial flagellate *Phæocystis*. On examination, this organism is found to exist in the form of spherical gelatinous masses containing numerous small greenish-brown cells. Later on, these balls of cells become sausage-shaped. Multiplication is very rapid, and at this season naturalists' tow-nets become so clogged up with *Phæocystis* that all the catches are spoiled. Its maximum occurs between the end of April and the beginning of June but there may be a secondary maximum in autumn. At Plymouth it appears regularly—nearly always in May—stays for a few weeks, and then disappears.

Water coloured by *Phæocystis* or diatoms has been given many names by fishermen in different places, such as 'weedy water', 'stinking water', and 'baccy juice'. It has been shown that the presence of *Phæocystis* in the North Sea may have an important effect on the herring fishery. Herring avoid a large mass of this 'coloured water' and will make a wide detour rather than go through it. In this way the shoals of fish may sometimes be deflected from their normal haunts and turn up in some other place where unexpectedly good catches will result while poor catches are obtained on the usual and generally highly productive fishing grounds.

Societies and Academies

LONDON

Royal Meteorological Society, April 26. C. S. DURST: The intrusion of air into anticyclones. An examination of the dynamical equations of a rotating fluid on a rotating globe shows that the descent of air in an anticyclone will cause an inflow towards the centre of the right order of magnitude to balance the outflow of air due to friction near the surface. An explanation is given of the empirical forecasting rule that warm-cored anticyclones are likely to endure. H. M. VERNON: The estimation of solar radiation in relation to its warming effect on the human body. The globe thermometers described consist of globes of copper, glass or pasteboard, painted black or covered with cloth, and with an ordinary thermometer fixed so as to have its bulb in the centre. Up to a certain point, the larger the size of such globes the higher the temperature indicated on exposure to solar radiation, but the limit is practically reached with globes 6–9 in. in diameter. The temperature then indicated corresponds with the warming effect of the solar radiation on the human body. Globe thermometers are considerably influenced by wind velocity. J. GLASSPOOLE: The rainfall over the British Isles of each of the eleven decades during the period 1820 to 1929. Maps are given defining the rainfall experienced over the British Isles during each of the eleven decades 1820–29 to 1920–29. The rainfall of each locality is given as a percentage of that for the standard period 1881–1915, so that each map presents a fairly simple distribution. The main feature of the distribution of rainfall during the decade 1920–29 was that excesses were most marked in the west of Great Britain, while during the decade 1910–19 the excesses were most marked in the south of England.

Geological Society, March 22. W. Wickham King: The Downtonian and Dittonian of Great Britain and north-west Europe. The discovery of a shell fauna (seven genera) and a gastropod in stages I. 5 to I. 9 of the English Downtonian series is described. The fishes and crustaceans known in the British Silurian rocks, and the fauna common to the Downtonian and Dittonian series, are set out. These, when combined with an examination of the physical conditions in the Siluro-Devonian period, afford a solution of the problem of the boundary between these two systems which is in agreement with the views of Norwegian geologists in relation to the Red Bay series of Spitsbergen. F. R. Cowper Reed: Downtonian fossils from the Anglo-Welsh area.

Dublin

Royal Irish Academy, Feb. 27. R. W. Ditchburn: The transmission of resonance radiation through a gas. In the first section the problem is formally reduced to a problem of transmission by absorption and scattering (as in a 'foggy' atmosphere). In the second section two general equations for this type of transmission are deduced. The relation $\nabla^2 E = K E$ (where E is the radiation density and K is constant) is shown not to be true. In the third section two special cases are considered: (*a*) transmission outwards from the centre of a sphere: (*b*) transmission outwards from the centre of a long cylinder.

Paris

Academy of Sciences, April 3 (*C.R.*, 196, 973–1056). Camille Matignon, Henri Moureu and Maurice Dodé: The causes of the simultaneous production of 1-butene and 2-butene in the course of the catalytic dehydration of butyl alcohol by alumina. The variations in the proportions of the two isomeric butenes obtained in this catalytic reaction have been traced to the presence of impurities in the alumina. Traces of acid favour the production of the 2-butene. J. Cabannes: The depolarisation of diffused light by a uniaxial crystal when the optic axis is parallel to the diffused ray. Experimental study and theoretical considerations. Jean Baptiste Senderens: The catalytic decomposition, in the gas phase, of the esters of the fatty acids by sulphuric acid pumice. Jules Haag was elected *Correspondant* for the Section of Mechanics, Gustave Binger for the Section of Geography and Navigation and Henri Devaux for the Section of Botany. Serge Finikoff: Surfaces the lines of curvature of which correspond with equality of the principal homologous radii of curvature. St. Golab: The conformal representation of two Finsler spaces. Soula: An integral equation. A. Tsortsis: The integration of a class of linear partial differential equations of the second order with an unknown function of n independent variables. Henri Cartan: Groups of pseudo-conformal transformations. Torsten Carleman: A differential inequality in the theory of analytical functions. F. E. Myard: An absolutely general linkage between any two axes of rotation in space. A. Magnan: The optical determination of the direction of threads of air in motion. Jean Baurand: Periodic progressive waves at the surface of a basin of small depth. P. Dumanois: Concerning the classification of liquid combustibles for internal combustion motors, with mechanical injection. Emile Sevin: The absorption of the cosmic radiation by the atmosphere. F. Prunier: Concerning the equations of electromagnetism. J. Granier: The conducting properties of india-rubber heavily loaded with lamp black. Vulcanised rubber containing 50 per cent of lamp black acts as a conductor for alternating currents and this conductivity appears to be electronic as it is not a function of the time and the electrodes show no trace of corrosion. The resistance varies with the pressure and various applications of this property are suggested. J. Lecomte: The infrared absorption spectra of some halogen derivatives of methane, studied with a recording spectrometer. A new type of instrument is described in which the photographic paper is fixed: the only moving part is the prism with an attached mirror. Data are given for eleven halogen derivatives of methane. P. Fleury and G. A. Boutry. The exact measurement of photographic densities. Use is made of a photoelectric cell working at constant deviation, thus eliminating the phenomena of lag and hysteresis. The negative (of density X) and a wedge (of variable density D) are superposed, realising the condition $X+D=\text{constant}$. The accuracy obtained is of the order of 0·1 per cent. F. Bourion, E. Rouyer and Mlle. O. Hun: The cryoscopic determination of the hydration of ions in solution. Jean Cournot and Mlle. Louise Halm: The measurement of the degree of polishing in view of the determination of the amount of corrosion of rustless steels. It has been shown that in studying the corrosion of chrome-nickel rustless steels the exact condition of the surface must be capable of definition. An apparatus based on the use of a photoelectric cell is described which has given satisfactory results. Augustin Boutaric and Mlle. Madeleine Roy: The influence of radioactive radiations on the flocculation of colloids. The experiments described clearly establish that the sensibility of the flocculation to the action of the radioactive radiation does not depend on the chemical constitution of the granules but only on their electric sign. Pierre Süe: The determination of niobium by orthoxyquinoline. Under conditions detailed, niobium pentoxide forms a microcrystalline precipitate with orthoxyquinoline: the niobium thus separated can be determined either gravimetrically or volumetrically. Guichard: Remarks on the atomic weight of iodine. The author gives reasons for preferring 126·91 to the International Commission figure, 126·932 and maintains the trustworthiness of direct determinations based on the use of iodine pentoxide. A. Tchakirian: The preparation of germanous iodide and the action of silver nitrate on the halogen derivatives of methane. Guy Emschwiller: The action of gaseous hydrogen iodide on some iodine derivatives of hydrocarbons: new methods of preparation of ethylidene iodide, vinyl iodide and methyliodoform. The reactions of gaseous hydrogen iodide with organic iodine compounds differ from those of aqueous hydriodic acid. Some new reactions are described leading to the preparation with good yields of ethylidene iodide, vinyl iodide and methyliodoform. Martin Battegay and Elsayed Hégazi : The chloride of thiourea, chloride of thionecarbamic acid or thiocarbamyl chloride. Raymond Furon : New observations on the extension of the Cretaceous and of the Eocene in the Niger Colony. D. Schneegans and G. Emilianoff : The presence of Tertiary strata in the Gabon basin (French Equatorial Africa). Pierre Urbain : The relative impermeability of the plastic sediments towards rain water, spring water and various alkaline solutions. Clays or marls may be impermeable to rain water and very permeable to spring water: hence the term impermeability has only a relative significance. Nicolas Menchikoff : The Devonian of Menakeb (Western Sahara). Georges and Boris Choubert : New tectonic observations on the Tabor massif. H. Colin and J. Augier : The soluble glycides of *Lemanea nodosa*. Floridoside and trehalose have been isolated from this alga. Muller and Desmarez : The differential microscopic characters of the bone of adult *Cynocephalus* and of human bone. It has been generally assumed that it is difficult, if not impossible, to differentiate the bone of the ape from human bone. The bones of the baboon, however, show characters clearly different from those of man. Abel Desjardins : The whirling vibrations of the organism. Eugène Donard and Henri Labbé : The co-existence in the rootlets of barley of hyperglycemiant and hypoglycemiant bodies. André Pacaud : An attempt at raising *Simodaphnia* and *Moina* in a synthetic medium. R. Guillemet and C. Schell : The sulphur of wheat, its nature and distribution. Correlation between the ratio of sulphur to nitrogen in wheat and the baking value of the flour. Gaston Ménier : Researches on the purification of air. A purifying apparatus.

Washington, D.C.

National Academy of Sciences (*Proc.*, 19, 1–207, Jan. 15, 1933). Albert Ernest Jenks : Minnesota Pleistocene *Homo*—an interim communication. On June 16, 1931, a skeleton was found in constructing a new road some three miles north of Pelican Rapids, in Pelican township of Ottertail county, Minnesota. The site showed no signs of a burial and was in laminated silt in the bed of a glacial lake (Glacial Lake Pelican). The skeleton is practically complete, possibly that of a woman aged seventeen years. The skull is that of an early form of *Homo sapiens*, of a generalised Mongoloid type, but shows noteworthy peculiarities. The skeleton was in sediment of late Pleistocene origin and has been named 'Minnesota man'. Photographs are reproduced. C. Judson Herrick : The functions of the olfactory parts of the cerebral cortex. In primitive types the olfactory system is the dominant feature of the cerebral cortex but in primates it is reduced to a subordinate position. At all stages of cortical differentiation, an important function of the olfactory cortex is to serve as a non-specific activator for all cortical activities. G. Karl Huber and Elizabeth C. Crosby : A phylogenetic consideration of the optic tectum. The tectum reaches its greatest morphological development in the reptiles and birds ; in mammals, the sensory centres of the cerebral cortex have taken its place as the major sensory correlation centre. S. R. Detwiler : Experiments upon the segmentation of spinal nerves in salamander embryos. Reduction in number of ganglia following removal of somites and increase following insertion of an additional somite, support Lehmann's view that normal segmentation of spinal ganglia is determined by mesodermal metamerism. Harlow Shapley : A contribution to the study of galactic dimensions. Data from observations on isolated cluster type Cepheids in high latitudes indicates that these Cepheids outline the galactic system and may be so much as 30,000 light years from the galactic plane. Along the galactic plane the dimensions are probably greater, but direct measurement is rendered difficult by absorption. Peter M. Millman : The theoretical frequency distribution of photographic meteors. Donald H. Menzel : A simple derivation of the dissociation formula. The argument starts from Boltzmann's formula for the distribution of atoms in different energy states. Dean B. McLaughlin : A suggested mechanism of class *Be* stars. The spectra of these stars show wide emission lines of hydrogen divided by absorption lines, and cyclic changes of the relative intensities of the two components of each emission line occur. The stars are considered as having atmospheres so extensive and rarified that, to a first approximation, their atoms pursue independent orbits as satellites of the star, while the star itself is a temperature variable. E. B. Mains : Host specialisation of *Erysiphe graminis Tritici*. Two physiological forms of the powdery mildew of wheat have been found. Carl D. LaRue : Regeneration in mutilated seedlings. Cotyledons and hypocotyls of many different families rooted in nutrient solutions. The effect of light is different in different species and sometimes even for the cotyledon and hypocotyl of the same species. When the cotyledons were removed, the remaining plumules failed to develop. B. S. Hopkins and L. L. Quill : The use of non-aqueous solvents in the study of the rare earth group. Differences in solubility of rare earth salts in water are small and separation is therefore difficult. Various alcohols and ethers have been tried as solvents. Ethyl ether proved useful for the separation of neodymium and praseodymium nitrates. L. O. Brockway and Linus Pauling : The determination of the structures of the hexafluorides of sulphur, selenium and tellurium by the electron diffraction method. A beam of electrons of uniform velocity intersect at right angles a jet of the gas, and the electrons scattered at right angles to the original beam are recorded photographically. The results indicate octahedral models and the following interatomic distances : S—F, 1·58 ± 0·03 A. ; Se—F, 1·70 ± 0·03 A. ; Te—F, 1·84 ± 0·03 A. Wilder D. Bancroft and John E. Rutzler, Jr. : The agglomeration theory of sleep. Sleep of various forms is postulated as due to reversible coagulation of some of the proteins of the centres of consciousness ; it can be counteracted by the irritability of the sensory nerves. A peptising agent such as sodium rhodanate decreases this sensory irritability, but an overdose may affect the centres of consciousness and prevent sleep. Henry Eyring : The zero point energy and the separation of isotopes. A theoretical discussion based on the view that separation of isotopes in processes involving velocity of adsorption is a special case of the general influence of zero point energy on reaction velocity. John R. Bates : The reaction of hydrogen atoms with oxygen and the hydrogen chlorine reaction. Wilder D. Bancroft, Robert S. Gutsell and John E. Rutzler, Jr. : Reversible coagulation in living tissue (11). Chronic alcoholism has been benefited by treatment with sodium rhodanate (peptisation therapy). (*To be continued.*)

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 22

Victoria Institute, at 4.30—(in the Central Hall, Westminster, S.W.1).—Prof. Albert Fleischmann: "The Doctrine of Organic Evolution in the Light of Modern Research".

Royal Geographical Society, at 5.30.—Squadron-Leader A. R. M. Rickards: "The Towns of Wadi du 'An and Hadhramaut" (*Geographical Film*).

Tuesday, May 23

London School of Hygiene and Tropical Medicine, at 3.15.—Dr. L. P. Lockhart: "Industrial Medicine as a Function of Public Health".*

Institute of Physics, at 5.15—(at the Royal Institution, 21, Albemarle Street, W.1).—H. Bradley: "Physics in the Boot and Shoe Industry".

Wednesday, May 24

University of Cambridge, at 5.—Sir Charles Sherrington: "Mechanism and the Brain" (Rede Lecture).

King's College, London, at 5.30.—J. L. Hammond: "The Growth of Common Enjoyment" (Hobhouse Memorial Lecture).*

Geological Society of London.—Discussion on "The Falling Water-Level in the Chalk under London", to be opened by H. Dewey.

Society of Chemical Industry (Food Group).—Annual General Meeting.

Thursday, May 25

Royal Society, at 4.30.—Dr. J. Chadwick: "The Neutron" (Bakerian Lecture).

London School of Hygiene and Tropical Medicine, at 5.—Dr. C. J. Thomas: "Physically Defective Children" (succeeding lecture on May 29).*

Courtauld Institute of Art, at 5.30.—P. Pelliot: "Recent Progress in Chinese Archæology".*

Chemical Society, at 5.30—(in the Meeting Hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1).—Prof. H. E. Armstrong: "Chemistry at the Cross Roads" (Hugo Müller Lecture).*

Official Publications Received

GREAT BRITAIN AND IRELAND

University Grants Committee. Returns from Universities and University Colleges in Receipt of Treasury Grant, Academic Year 1931–32. Pp. 26. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

British Chemical Abstracts. Issued by the Bureau of Chemical Abstracts. Index 1932. Pp. 578. (London: Society of Chemical Industry.)

Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 36: *Experiments on the Suitability of some Rectifier Photo Cells* for the Measurement of Daylight. By Dr. H. H. Poole and Dr. W. R. G. Atkins. Pp. 537–546. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Proceedings of the Royal Society of Edinburgh, Session 1932–1933. Vol. 53, Part 2, No. 9: The Intellectual Resemblance of Twins. By Louis Herrman and Prof. Lancelot Hogben. Pp. 105–129. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 2*s*. 9*d*.

City of Leicester Municipal Libraries. Catalogue of Books on Gardening, Poultry and Bees. Pp. 15. (Leicester.)

Natural Science and Archæology Society, Littlehampton. Reports of Proceedings, 1931–1932. Pp. 32. (Littlehampton.)

The Carnegie United Kingdom Trust. Nineteenth Annual Report (for the Year ending December 31, 1932) approved by the Trustees on Saturday, March 11, 1933. Pp. ii+88. (Dunfermline.)

The Scottish Forestry Journal: being the Transactions of the Royal Scottish Forestry Society. Vol. 47, Part 1, March. Pp. xx+91+21. (Edinburgh: Douglas and Foulis.) 7*s*. 6*d*.

The Institution of Professional Civil Servants. Annual Report of Council for the Year 1932. Pp. xiii+60. (London.)

The National *Physical* Laboratory. Report for the Year 1932. Pp. vi+277+17 plates. (London: H.M. Stationery Office.) 14*s*. net.

Journal of the Chemical Society. April. Pp. iii+329–471+vi. (London: Chemical Society.)

The Proceedings of the Physical Society. Vol. 45, Part 3, No. 248, May 1. Pp. iv+367–491. (London: Physical Society.) 7*s*. net.

The Ross Institute and Hospital for Tropical Diseases. Annual Report and Accounts for 1932. Pp. 96. (London.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 6 (New Series), No. 3, March. Abstracts Nos. 374–577. Pp. 73–108. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

Journal of the Royal Microscopical Society. Series 3, Vol. 53, Part 1, March. Pp. xii+108. (London: Royal Microscopical Society.) 10*s*. net.

The Annual Report of the Visitors of the Royal Institution of Great Britain for the Year ending December 31, 1932. Pp. 25. (London: Royal Institution.)

OTHER COUNTRIES

Smithsonian *Miscellaneous* Collections. Vol. 89, No. 4: Scouting for a Site for a Solar-Radiation Station. By A. F. Moore. (Roebling Fund.) (Publication 3212.) Pp. 23+4 plates. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 10, No. 3, March, Research Papers Nos. 531–539. Pp. 289–426. (Washington, D.C.: Government Printing Office.) 25 cents.

University of California Publications in Zoology. Vol. 37, No. 17: The Occurrence of Streptostyly in the Ambystomidæ. By Theodore H. Eaton, Jr. Pp. 521–526. 25 cents. Vol. 38, No. 6: Amphibians and Reptiles from Lower California. By Jean M. Linsdale. Pp. 345–386. 35 cents. Vol. 38, Nos. 7 and 8: An Unrecognised Shrew from New Jersey, by Morris M. Green; A Relic Shrew from Central California, by Joseph Grinnell. Pp. 387–390. 25 cents. Vol. 38, No. 9: New Mammals from St. Lawrence Island, Bering Sea, Alaska. By E. Raymond Hall and Raymond M. Gilmore. Pp. 391–404+plates 5–6. 25 cents. Vol. 38, Nos. 10 and 11: A New Lake-side Pocket Gopher from South-Central California, by Joseph Grinnell; A New Pocket Gopher from New Mexico, by E. Raymond Hall. Pp. 405–413+plate 7. 25 cents. Vol. 38, No. 12: Remarks on the Affinities of the Mammalian Fauna of Vancouver Island, British Columbia; with Descriptions of New Subspecies. By E. Raymond Hall. Pp. 415–423. 25 cents. (Berkeley, Calif.: University of California Press.)

Royal Zoological Society of New South Wales. Bibliography of Australian Entomology, 1775–1930; with Biographical Notes on Authors and Collectors. By Anthony Musgrove. Pp. viii+380. (Sydney.)

Memoirs of the Queensland Museum. Vol. 10, Part 3, March 14. Pp. 131–156. (Brisbane.)

Legislative Assembly: New South Wales. Report (together with Appendices) of the Minister of Public Instruction for the Year 1931. Pp. 39. (Sydney: Alfred James Kent.) 2*s*. 6*d*.

Liverworts of the Western Himalayas and the Panjab Plain. Part 1, Supplement. By Prof. Shiv Ram Kashyap. Pp. 10. Part 2. By Prof. Shiv Ram Kashyap, assisted by Ram Saran Chopra. Pp. iii+137+31 plates. (Lahore: University of the Panjab.)

Report of the Haffkine Institute for the Year 1931. By Lieut.-Col. J. Taylor. Pp. 72. (Bombay: Government Printing and Stationery Office; London: High Commissioner for India.) 6 annas; 8*d*.

Proceedings of the Imperial Academy. Vol. 9, No. 2, February. Pp. iii–iv+31–81. (Tokyo.)

Government of India: Department of Industries and Labour. Functions and Organisation of the India Meteorological Department, 1933. Pp. 19. (Simla: Government of India Press.)

Ontario Research Foundation. Report for the Year 1932. Pp. 39. (Toronto: Herbert H. Ball.)

Union of South Africa. Report of the South African Museum for the Year ended December 31, 1932. Pp. 18. (Pretoria: Government Printer.)

Cornell University: Agricultural Experiment Station. Bulletin 548: Corn and Soybeans for Silage. By R. G. Wiggans. Pp. 36. Bulletin 552: The Effect of certain Mineral Elements on the Color and Thickness of Onion Scales. By J. E. Knott. Pp. 14. Memoir 143: Studies on the Downy Mildew of Onions, and the Causal Organism, *Peronospora destructor* (Berk.) Caspary. By Harold Thurston Cook. Pp. 40. Memoir 144: The Physical Volume of Production in the United States. By G. F. Warren and F. A. Pearson. Pp. 72. (Ithaca, N.Y.)

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 11, No. 8: Observations on the Life History of the Marbled Salamander, *Ambystoma opacum* Gravenhorst. By G. K. Noble and M. K. Brady. Pp. 89–132. (New York City.)

University of California Publications in American Archæology and Ethnology. Vol. 31, No. 5: The Cocopa. By E. W. Gifford. Pp. 257–334. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 1 dollar.

U.S. Department of Agriculture. Technical Bulletin No. 345; Biology and Morphology of the Spindle Worm or Elder Borer. By J. C. Silver. Pp. 20. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the United States National Museum. Vol. 82, Art. 17: A New Nematode from the Rhea. By Everett E. Wehr. (No. 2958.) Pp. 5. (Washington, D.C.: Government Printing Office.)

CATALOGUES

Catalogue of Important Works on Florists' Flowers, Floras, Cryptograms and Horticulture. (No. 21.) Pp. 20. (London: John H. Knowles.)

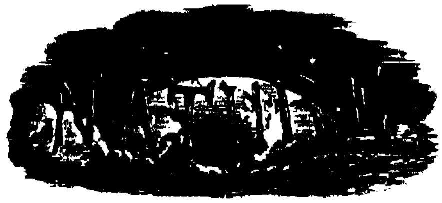
Research and Testing Equipment. Pp. 78. (*Manchester: Metropolitan-Vickers Electrical Co., Ltd.*)

Radio-Malt. Pp. 6. (London: The British Drug Houses, Ltd.)

Inexpensive Photography. Pp. 20. (London: Burroughs Wellcome and Co.)

Books relating to Bibliography and the Production of Books. (Catalogue No. 559.) Pp. 36. (London: Francis Edwards, Ltd.)

Classified List of Second-hand Scientific Instruments. (No. 108.) Pp. vi+58. (London: C. Baker.)



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Language in the Service of Science

SEEKERS after truth in Nature have always been regarded as disturbers of the peace and associates of the Evil One. It is not surprising, therefore, that throwing stones at men of science is a practice dating from very early times ; and it still continues, if in a somewhat different form. Since the powers of evil were let loose during the War, the earlier pebbles of theology have been largely replaced by the heavier stones of sociology, as expressed in a prize-epigram in the *Spectator* :

> Science finds out ingenious ways to kill
> Strong men, and keep alive the weak and ill—
> That these a sickly progeny may breed,
> Too poor to tax, too numerous to feed ;

and more recently science has been indicted as a primary cause of unemployment. There is, however, an older missile that critics, chiefly literary men, never cease to hurl : the man of science, they say, cannot make himself intelligible to ordinary people ; he abuses the English language, and has little or no literary feeling. Dr. Cyril Norwood, the headmaster of Harrow School, in a recent Friday evening discourse at the Royal Institution on "The Use of the English Language", allies himself with these critics, but his stones are so soft and so polished, and the material of them is so excellent, that, far from doing harm, they should do good, even if they only disturb the still waters of complacency.

In our rightful efforts to be natural, says Dr. Norwood, we easily become careless in the use of words and slip into colloquialisms, and even slang. Men of science labour under the further disadvantage, peculiar to themselves, that they have to use a highly technical vocabulary which, however intelligible it may be to students of the particular science, is frequently meaningless to ordinary men and women. "The use of technical terms may very easily lead writers to employ language as a set of symbols only, and they may lose all sense of living words." Technical language is a necessity, but its use is frequently overdone, and "men of science, even when writing for each other in scientific periodicals, would find that it would repay them to write as clearly and attractively as they can. They should regard technical and specially invented terms as a necessary evil, an instrument to be employed as sparingly as possible. For one of their main purposes must of necessity be the instruction of the general educated public who are not specialists in any sense, and certainly in the propagation of ideas one who can explain himself in language which ordinary men and women can understand has a great advantage over one who has not this power".

Scientific workers will, we believe, agree generally with Dr. Norwood's moderately-worded statements, but it will be news to many that instruction of the general public is one of their main purposes. Perhaps it should be; but there are few signs that it is so now. The investigator who is inclined to assume the rôle of populariser believes that if he does so his colleagues will accuse him of being superficial and inaccurate. There is, further, a doubt whether, as a rule, he is qualified to act in this capacity; for good popular exposition demands qualities that have little or no connexion with those which make for success in scientific research. The populariser of knowledge must be able to woo or conquer his reader's attention by favour or by force; he must steer a clear course between academic phraseology and the jargon called 'journalese'; he requires imagination to see things as ordinary people see them; and, last but not least, he needs a sense of style. Ability to write or to speak plainly and pleasantly is seldom associated in the same individual with ability to do original work—there are, of course, some notable exceptions—and it would be well if this fact were recognised by the popular Press, which has lately gone to extremes in 'animating' objective description by over-emphasising the personal element. We all realise the advantage of hearing or reading the words of a discoverer or author as they flow hot from his mouth or fountain-pen, provided he is a capable exponent; but we also realise how wise was Johnson to have a Boswell, and how fortunate was Darwin to have a Huxley and a Ray Lankester as disciples.

The question of technical vocabulary is admittedly difficult. Although most would agree that in certain sciences there are words and expressions that almost or quite defy translation into ordinary language, yet in the great majority of sciences, pure and applied, it is possible to do so, if with some loss of precision, by using suitable devices, such as periphrasis and analogy. These, however, should be employed with caution, because periphrasis is the fruitful mother of jargon, and analogy, when false or faulty, has ever been an *ignis fatuus*, leading to wrong turns in science, religion and philosophy, and so blocking their progress. Men of science and technologists nearly always write and speak as if they are addressing one another, although the slang they use, like common slang, is concise, and often remarkably expressive—to themselves. These remarks, however, apply with equal force to other professional workers: lawyers, economists, stockbrokers, architects, musicians and other professional men, all use their own special jargon, which few laymen can properly understand. Language has been compared with a living organism: it grows by assimilating more material than it discards, but its general structure remains intact. The simpler words that make the backbone of a natural language stand fast against the accidents of time and the desecrations of the profane; they are and will remain the best for common use.

On the point of clear and attractive writing, it will be admitted that scientific men are, as a rule, far too engrossed in their special subjects to give much heed to style or method of presentation. A clear, brisk, and accurate style is, however, within the compass of all; but it requires effort. "All beautiful work," said Ruskin, "is the easy result of long and painful practice"; and if the man of science will not learn the rules of good writing and concentrate on applying them, he can only blame himself if he fails to make himself understood, and if another succeeds in reaping where he has sown.

The word 'style' has several meanings: it may mean personal idiosyncrasy in expression; or mere ornament; more often, and perhaps more correctly, it means the power of expressing lucidly a sequence of ideas; but however it be defined, fundamentally it consists in choosing the right words and arranging them properly. "Style is connexion; art is putting things in their places," said the Master of Balliol (Jowett); and though we may hold his definition of art to be inadequate, we cannot dispute that, fundamentally, style *is* connexion: the connecting of words, of clauses in a sentence, of sentences in a paragraph, and of paragraphs in a composition; and all with the object of attaining clear and precise expression.

The secret of a lucid style, as Dr. Norwood reminds us, is to simplify: cut out the redundant words, first the nouns and then the adjectives; avoid where possible the use of abstract nouns and long words; and beware of circumlocutions! Observance of these simple rules will go far to produce a good style; but a few more may be added, for example, prefer the active form of the verb to the passive; avoid the use of too many noun-adjectives; and study the use of hyphens.

The noun-adjective is often clumsy or ambiguous, and the rules or conventions for the proper use of hyphens (see Tract No. VI of the Society for Pure English) are honoured far more in the breach than in the observance in modern scientific literature.

The other main element in a good style is precision. "The chief aim in style," said Flaubert, "ought to be absolute precision. There is only one noun that can express your idea, only one verb that can set that idea in motion, and only one adjective that is the proper epithet for that noun." The chief obstacles to precise statement are want of clear thinking; bad choice of words; using too many abstract nouns, preposition-verbs, and circumlocutions; and faulty arrangement. Metaphors and analogies are useful in popular description, but find little place in rigidly scientific prose, as they often lack precision. Conciseness, first cousin to clarity, does not always make for precision, at least not for Flaubert's "absolute precision". It is possible to be too concise (as readers of many modern abstracts are aware) and to introduce ambiguity by cramming a maximum of meaning into a minimum of words. On the other hand, what is more tedious than reading a treatise by an author who leaves nothing to his reader's imagination, and disgorges the whole contents of his mind in sentences replete with qualifications and elaborations? The artist, it has been said, is known rather by what he omits. Can we not all emulate the artist in this respect?

Other hall-marks of a good style are variety and sobriety. Although often guilty of monotony, scientific writers of to-day can seldom be accused of want of sobriety; they err rather in the opposite direction, except when they make two or more words do the work of one. The populariser must, of course, be allowed some licence; he has to fix and maintain the attention of his audience; and if at times he tries to imitate authors like Shaw and Chesterton by immoderate use of hyperbole, paradox, parody, and alliteration, he may be forgiven on the ground that the end justifies the means. Nevertheless, the elements of style are essentially the same for popular scientific, purely scientific, and ordinary literary description. If the writer of science is to be as successful as the literary man in his appeal to the educated public, he must observe the 'rules of the game', and furthermore, he must cultivate that priceless possession of the true artist and the real man of science, the passion to excel, which is at the root of all the best work that is done in the world.

Metals and Civilisation

Man and Metals: a History of Mining in relation to the Development of Civilisation. By Dr. T. A. Rickard. Vol. 1. Pp. xiii+506. Vol. 2. Pp. v+507–1068. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 50*s*. net.

BUCKLE devoted six volumes to an introduction to the history of civilisation. Dr. T. A. Rickard gives us two bulky volumes on a single aspect of this subject, an aspect somewhat neglected by Mr. H. G. Wells, namely, the relation of mining and the use of metals to the development of civilisation.

It may reasonably be said that no man living is better qualified to write on this subject than Dr. Rickard. He was trained at the Royal School of Mines, London. Since his student days he has spent nearly fifty years as a mining engineer, mine manager and consultant in various parts of the world, but chiefly in the United States. He has been editor successively of three leading mining journals. He is also the author of several textbooks on mining subjects.

In his introductory chapters, Dr. Rickard shows how man emerged from savagery by the aid of tools, first of wood and stone, then of metal. In the masterly review of the history of mining which follows these introductory chapters, the author shows how the search for metals has aided the spread of civilisation in ancient times, in the Middle Ages, and in our own era. Also how the use of metals for money, credit, machinery, transport, communication and war has been a fundamental factor in the development of our present world-wide civilisation.

The author also dwells on the perversity of mankind through which a blessing is often converted into a curse. In the earliest times "the sword was made before the ploughshare"; in the immediate future "shall we mend our ways or go with the Gadarene swine down the steep slope of perdition?" "The history of mining, like all other history, thunders a warning."

Dr. Rickard is a philosopher as well as a historian and an engineer; he is also a careful student. The dedication of his book "To the Librarians" indicates his appreciation of the work of others. The lengthy lists of references at the end of each chapter are evidence of the care with which he has studied his subject. Nevertheless, the treatment in places seems to follow the preconceived methods of some mining geologists rather than the cautious following of the reef characteristic of the old-fashioned mining engineer. Dr. Rickard condemns rather thoroughly the legend of King Solomon's mines in Rhodesia and prefers the later theory that they are of recent Bantu origin. He offers no explanation of the destination of the very large amount of gold apparently taken from these workings, or of the workmanship of the gold ornaments, or of the finely made crucibles apparently used for assaying. These crucibles were turned on a wheel, not Bantu work, and may be found also around the ancient workings of Rouiberg and Blaubank in the Transvaal. These crucibles in *both* countries are characterised by a herring-bone pattern round the rims. The objections to South Africa not being regarded as a great centre for bronze and copper production are similar. The Middle Ages had no use for the million tons of copper estimated by Dr. P. A. Wagner to have been produced: nor is there any record of the thousands of tons of tin produced being shipped to Europe in the Middle Ages. In one district alone there are the remains of forty-six furnaces and enormous quantities of slag. The occurrence of nickel in ancient bronzes does not seem explicable from the limited Hungarian and Asiatic sources alone, but, as Dr. Rickard remarks, the chemical analysis of metallic relics has been sadly neglected. Many a "Green-stained piece of old metal" has been assumed to be bronze when often it was copper. He also, on geological grounds, denounces as fable the stories of the rapid submergence of Leonesse in November 1099.

Again, Dr. Rickard bases some important conclusions on the statement that the pre-Roman Britons only possessed tools of wood and deers-horn. From "across the pond" we must remind him that Cæsar's world-victorious army was defeated again and again and finally driven from Britain in 55 B.C.—surely not with tools of wood and deershorn! The Romans did not finally conquer Britain for another hundred years although attempts were made.

In these days of specialised study, it is often easy to find fault with any book which deals with a very wide subject. Dr. Rickard's main conclusion is well and truly established; he has shown convincingly the intimate relation between the history of mining and the history of man's development from savagery, through barbarism to civilisation. B. W. H.

A Photogrammetric Survey in the Pamir

Wissenschaftliche Ergebnisse der Alai-Pamir Expedition 1928. Im Auftrage der Notgemeinschaft der Deutschen Wissenschaft. Herausgegeben von Dr. H. v. Ficker und Dr. W. R. Rickmers. Teil 1: *Geodätische, Topographische und Glaziologische Ergebnisse.* Von Dr. Richard Finsterwalder. Band 1: *Geodätischer und glaziologischer Teil.* Pp. x + 218 + 23 plates. Band 2: *Kartenbeilagen.* 12 maps. Teil 2: *Geologische Untersuchungen im nordwestlichen Pamir-Gebiet und mittleren Transalai.* Von Dr. Ludwig Nöth. Band 1: *Stratigraphie (ausschliesslich Quartär), Tektonik.* Pp. viii + 130 + 3 maps. Band 2: *Quartäre Ablagerungen, Morphologie.* Pp. v + 131–211 + 24 plates. Teil 3: *Beiträge zur Faunistik des Pamir-Gebietes.* Von Dr. W. F. Reinig. Band 1: *Ökologie und Tiergeographie.* Pp. viii + 195. Band 2: *Systematischer Teil.* Pp. iv + 196–312 + 6 plates. (Berlin: Dietrich Reimer (Ernest Vöhsen) A.-G., 1932.) 6 vols., 175 gold marks.

THE Alai-Pamir expedition was a joint undertaking of the Notgemeinschaft der Deutschen Wissenschaft and the Academy of Sciences of the U.S.S.R., and its object was to explore the almost unknown north-western part of the Pamir. The sheet of the general map which accompanies these volumes extends from 72° E. to 73° 45′ E. and from 38° 30′ N. to 39° 40′ N., and most of this area was surveyed in greater or less detail. The actual survey reaches from the Kisil-su on the north to the southern border of the sheet, and from the Garmo Peak on the west to the Pamirski Post road on the east, stretching beyond that road in the Transalai and in the neighbourhood of Lake Karakul. The area covered by the survey is about 15,000 square kilometres.

The expedition entered this area at the north-east corner on June 27 and left at the north-west corner on Oct. 16, and the topographical map is a truly remarkable result for less than four months' work in so difficult a region. That so much was accomplished is due to the foresight with which the expedition was planned and to the fact that the survey was made by terrestrial photogrammetric methods and was plotted with the stereo-autograph after the return to Europe. No previous expedition in unknown country has relied so entirely upon these methods, and the very practical account given by Dr. Finsterwalder should be valuable to workers in other areas. He deals not only with the observations in the field but also with the subsequent preparation of the map, by the field observers themselves, with the help of the stereo-autograph. The chief instrument used in taking the photographs was the light phototheodolite of Zeiss; but where the difficulties of access were too great, a still lighter photogrammeter, without theodolite and using smaller plates, was employed for supplementary observations. Other instruments were used for triangulation and for field astronomy, and the astronomical position of several points was accurately fixed by Belajeff, one of the Russian coadjutors, with a more complete astronomical equipment. Two stations of the Russian Pamir Triangulation were found and thus the survey was linked with previous work. Certain discrepancies between astronomical and geodetic positions indicate deflections of the plumb-line which deserve closer investigation.

The area examined varies greatly in character. Towards the south-east it is a dry plateau where rock-waste accumulates and the hills are low and tame. Towards the west and south-west the rainfall increases, snow gathers on the higher ground, and large glaciers flow out from extensive snowfields. The valleys here are deeply cut and the hills are rugged, especially near the Garmo Peak. On the north is the high chain of the Transalai, with smaller snowfields and glaciers, and beyond this lie the steppes of the Alai Valley, through which the Kisil-su flows from east to west.

The most interesting part of the region, from the morphological point of view, is the glaciated area of the west and south-west. The topographers spent some eight weeks here, the survey was made in considerable detail, and the rate of movement of two of the greatest glaciers was determined. The method by which this rate was measured shows some of the advantages of photogrammetry. From the ends of a measured base upon the bank photographs are taken with the photo-theodolite, looking across the glacier. After the lapse of a few days one at least of these photographs is repeated. With the stereo-autograph there is then no difficulty in determining with considerable precision the distance which any stone or other well-defined mark upon the glacier has moved during the interval. In sunny weather this interval must not be too long or some of the movement of a stone may be due to melting of the ice. One of the glaciers of which the rate was determined was the Fedchenko Glacier, the most remarkable of all. It flows from south to north, at right angles to the general trend of most of the main valleys. Its length is about seventy-four kilometres and Finsterwalder thinks that it is probably the longest glacier on the earth outside the polar regions.

A geologist can do nothing where the rocks are covered with snow, and accordingly Dr. Nöth devoted his attention chiefly to the north and east of the region. With the help of the observations of his colleagues he has produced a geological map of the whole area, but he is fully aware that such a map can be no more than an imperfect sketch. It will, however, be useful both to the reader and to any subsequent worker in the region.

By far the greater part of the north-western Pamir consists of Palæozoic and older rocks, with large intrusive masses. Lower Carboniferous beds have been definitely recognised, Middle Devonian and Permian beds with less certainty. The folding of these rocks was completed in the Permian period and the mass was raised above the sea. The Mesozoic era was a quiet time during which a surface of low relief was produced by erosion, the hills which rose above the general level being worn down, while in depressions below that level Mesozoic sediments were locally deposited. The Transalai range, on the northern border of these ancient rocks, is geologically distinct. Its northern slope consists of Cretaceous and Tertiary beds which have been strongly folded by a northward movement of the Pamir mass. This folding was completed in Miocene times and since then there has been no great change of form in any part of the region; but the valleys upon the western border have been deepened by ice and river erosion, while in the dry interior the rock-waste produced by weathering remains. Two glacial periods can be recognised, during the first of which the glaciated area was considerably more extensive than during the second.

Dr. Reinig, the zoologist of the German party, began to collect in the Fergana basin, before the expedition had reached its chief objective. He left the main party near Lake Karakul and travelled through the south part of the Pamir as far as Langar, near the border of Afghanistan. Accordingly, he deals with a much wider area than his colleagues. In the circumstances it was impossible to preserve or transport soft-bodied animals. Therefore he collected chiefly insects, paying special attention to bees and Tenebrionidæ, which, on account of their variability, might be expected to yield the most valuable results. He gives a useful general account of the orography, climatology and vegetation of the whole region; but perhaps his most interesting chapter is that upon the origin of the Pamir fauna. Owing to its cold and dry climate the fauna of the High Pamir is much poorer, both in species and in individuals, than that of the milder and moister western valleys; but there are differences which cannot be due entirely to climate. During the first glacial period much of the Pamir was covered by ice, and animal life must have been greatly reduced. Most of the present fauna has entered the area since the ice retreated, and Dr. Reinig shows that there has been immigration both from the west and from the east. Another chapter, of special interest to zoologists, deals with variation in the Hymenoptera and Tenebrionidæ.

The whole work is beautifully produced and the volumes are very convenient to handle and read. The paper is thick and strong but very light, and the print is clear. The numerous photographic views and panoramas are well reproduced and the maps and sections leave nothing further to be desired. Besides the general topographic map on the scale of 1 : 200,000 and the geological map upon the same scale, there is another with the contours in blue and the trigonometrical nets in red, and a transparent sheet showing the photogrammetric lines. There are also special maps of the greater glaciers on a larger scale, sections of two of them showing the rate of movement, and a sheet of geological sections. PHILIP LAKE.

The Play of Thought in Progress

Adventures of Ideas. By Prof. Alfred North Whitehead. Pp. xii + 392. (Cambridge: At the University Press, 1933.) 12*s.* 6*d.* net.

THIS is a book so rich in thought and covering so many fields of human experience that it is quite impossible to summarise or render an adequate account of it within the limits of a review. It is emphatically a book to be bought, read, re-read, and pondered. Not everyone will agree with the author's views, which are the expression of a highly individual philosophy, a particular attitude towards the problems of existence, but no one can read the book without receiving help and stimulus from the wisdom that permeates it and flashes into brilliance in many pregnant phrases.

The book is complementary to "Science and the Modern World" and "Process and Reality", but is complete in itself, and can be read without previous acquaintance with Whitehead's philosophy. There are four sections. The first deals with the influence exerted by Platonic, Roman, and Christian ideas upon the development of Western civilisation.

In a few vivid chapters, Whitehead traces the growth of the humanitarian ideas which originated first as the intuitions of genius, and slowly made their way in the world, as the world ripened to receive them. Thus "at the close of the Dark Ages Europe started upon its second effort after civilization with three main advantages: its Christian ethics: its instinct for legal organization transcending local boundaries, derived from the Church and the reminiscence of the Empire: and thirdly its wider inheritance of antecedent thought, gradually disclosing itself as Hebrew, Greek, and Roman literatures. The total effect was the increased sense of the dignity of man, as man. There has been a growth, slow and wavering, of respect for the preciousness of human life. This is the humanitarian spirit, gradually emerging in the slow sunrise of a thousand years" (p. 105). This is what Whitehead means by the adventure of ideas in the history of the human race—their influence in promoting "the slow drift of mankind towards civilization".

There is, too, in all great thought an element of adventurousness—fresh ideas represent something novel, untested, unsafe: they are a leap in the dark. It is of the essence of life itself that it is a striving after expansion and novelty. It is "an offensive, directed against the repetitious mechanism of the Universe. . . . Life can only be understood as an aim at that perfection which the conditions of its environment allow. But the aim is always beyond the attained fact" (p. 102).

A civilisation which has become static, which rests content with accepted ideas and customs, which puts safety first and refuses the adventure of ideas, is a civilisation about to decay. It can be rescued and transformed only by the influence of fresh ideas, new ends to pursue. "The foundation of all understanding of sociological theory—that is to say, of all understanding of human life—is that no static maintenance of perfection is possible. This axiom is rooted in the nature of things. Advance or Decadence are the only choices offered to mankind. The pure conservative is fighting against the essence of the Universe'

(p. 353). Our present civilisation has reached a period of stagnation and is doomed to slow decline unless some fresh and revivifying creative ideal emerges. Let us hope, with Whitehead, that "our present epoch is to be viewed as a period of change to a new direction of civilization".

In the second section of the book, Whitehead deals in similar fashion with the influence of scientific ideas upon European culture. Here again we meet with a rich tangle of thought to which a reviewer can do but poor justice. There is a valuable discussion of the main doctrines concerning the laws of Nature, of which Whitehead distinguishes four—the doctrine of law as immanent, the doctrine of law as imposed, the doctrine of law as mere description, and the more modern doctrine of law as conventional interpretation. The influence of these varied conceptions of natural law upon scientific cosmologies is traced out historically.

Linked with this general discussion is a brilliant treatment of the interplay of "speculation" and "scholarship"—another facet of the adventure of ideas. Their contrast is exemplified by the Greeks of the classic period and the later Alexandrians. "The note of Hellenism is delight, speculation, discoursive literature: the note of Hellenistic Alexandria is concentration, thoroughness, investigation of the special types of order appertaining to special topics". Both are necessary for the advance of knowledge and understanding, but their proper balance is rarely achieved.

Nowadays, according to Whitehead, the balance has tipped too far in the direction of "scholarship". "Modern scholarship and modern science reproduce the same limitations as dominated the bygone Hellenistic epoch, and the bygone Scholastic epoch. They canalize thought and observation within predetermined limits, based upon inadequate metaphysical assumptions dogmatically assumed. The modern assumptions differ from older assumptions, not wholly for the better. They exclude from rationalistic thought more of the final values of existence. The intimate timidity of professionalized scholarship circumscribes reason by reducing its topics to triviality, for example to bare sensa and to tautologies. It then frees itself from criticism by dogmatically handing over the remainder of experience to an animal faith or a religious mysticism, incapable of rationalization" (p. 151). New directions of thought are required, and they will come through flashes of intuition, commencing as "sheer ventures of rash speculation", which will be tested, criticised, exemplified, extended, by the patient work of scholarship and research.

The third part of the book is headed "Philosophical" and it contains a condensed account of Whitehead's own system of philosophy. It is extremely hard reading, and is likely to be refractory to any but the professional metaphysician. For this reason, no attempt will be made here to expound it.

The last section deals with truth, beauty, art, adventure, peace, as qualities which should characterise a civilised society. The last two chapters are particularly fine; in them Whitehead frees his thought from its often difficult and obscure expression and writes vividly and clearly. It is in these chapters that one can best grasp the purport of the book, and share the vision of reality which our great poet-philosopher offers us.

I conclude with one further quotation, which gives some notion of what Whitehead means by "Peace". "The vigour of civilized societies", he writes, "is preserved by the widespread sense that high aims are worth while. Vigorous societies harbour a certain extravagance of objectives, so that men wander beyond the safe provision of personal gratifications. All strong interests easily become impersonal, the love of a good job well done. There is a sense of harmony about such an accomplishment, the Peace brought by something worth while" (p. 371).

E. S. R.

Short Reviews

Strahlenoptik. Von Dr. M. Herzberger. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R. Courant, Band 35.) Pp. xiii + 196. (Berlin: Julius Springer, 1931.) 19.40 gold marks.

THIS volume, which is not a textbook, embodies recent work by the author and other workers, carrying this further in an attempt to give a unified exposition of erstwhile geometrical optics, not by the usual devious routes but rather by consistent application of the original method of Hamilton. The author goes far towards achieving this, although finding himself compelled to resort to conventional methods when considering the limitation of rays. The subject, still in essence geometrical optics, gains considerably in perspicuity by reason of the inherent advantages of the method and the conciseness of Herzberger's treatment. The author's additions to the terminology are not such obvious gains.

As befits one of a well-known series of mathematical monographs, the treatment most appropriate to the subject has been employed. This assumes substantial acquaintance with the properties of matrices and the vector method, such as rather to limit the appeal of the work among average students.

The book, consisting of eight parts, may be considered in two divisions. In Parts 1–4, after a brief general consideration of systems in anisotropic media, the basis is laid for the subsequent treatment, ray-tracing formulæ being given incidentally. The chapter on Gaussian optics includes consideration of the general case with references to Gullstrand.

In Parts 5–8, devoted to the theory of aberrations, a system of first order aberrations is worked out without applications, and generalities are given for finite aperture and field. The author follows T. Smith closely, the last part being confined entirely to work by this writer.

Adequate bibliographical reference is for the most part given, although one misses mention of certain names which suggest themselves in places (for example, Rayleigh, Schwarzschild).

Handbuch der physikalischen und technischen Mechanik. Herausgegeben von Prof. Dr. F. Auerbach und Prof. Dr. W. Hort. Band 3: *Statik und Dynamik elastischer Körper nebst Anwendungsgebieten, zum Gebrauch für Ingenieure, Physiker und Mathematiker.* Pp. ix + 468. 32 gold marks. Band 4, Hälfte 1: *Statik und Dynamik elastischer Körper nebst Anwendungsgebieten, zum Gebrauch für Ingenieure, Physiker und Mathematiker.* Lief. 1. Pp. vi + 198. 16 gold marks. Lief. 2. Pp. xiv + 199–636. 72 gold marks. Band 4, Hälfte 2: *Technische Physik der festen Körper, zum Gebrauch für Ingenieure, Physiker und Mathematiker.* Pp. xiii + 614. 75 gold marks. (Leipzig: Johann Ambrosius Barth, 1927–1931.)

THIS monumental handbook in seven volumes now nears completion, the only outstanding parts to be published being the conclusion of vol. 5 (on the mechanics of fluids) and the complete index for the whole work. Of the volumes here noticed, the first (vol. 3), besides covering familiar ground in elasticity, includes an article on earthquakes and seismic waves, by Gutenberg. Vol. 4 ranges over a wide field of technical elasticity and the properties of matter, and summarises much work that is not otherwise easily accessible in collected form. Among the articles may be mentioned several on crystal structure (including one on polycrystals and their investigation by X-rays), two on the growth- and deformation-texture of organic substances and of metals, and one on workshop testing of materials. A regrettable feature of the publication is the very high price (particularly in sterling) of the last published, vol. 4.

Methods of Social Study. By Sidney and Beatrice Webb. Pp. vii + 263. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 8*s*. 6*d*. net.

THIS excellent work gives the prolegomena to an applied science of society. The authors think that sociology has reached the stage occupied by the physical sciences a century ago; and that scientific method can be strictly applied to help the theoretical and practical progress of sociology. Such developments as the adoption of an official audit in public administration, the recruitment of civil servants and the organisation of trade unions, are not merely the outcome of blind forces hazily understood by the trial and error method, but the result of hypotheses actually arrived at by social workers and philanthropists working along the lines of scientific method. The authors of this work then discuss questions relating to the mental equipment of the social investigator, to the study and compiling of social facts and to the use of statistics. The great difference between social and physical sciences is given by their object: "Treasure your exceptions" should be the motto of the first; "scrap your exceptions" seems to be the physicist's point of view. Hence the social problem is not to find out how to get men and women to fit into society, but how to make a society into which will fit the men and women with all their differences and peculiarities of character, health and occupation. T. G.

Zoologie der Madagascar. Par G. Grandidier et G. Petit. Pp. 258 + 48 plates. (Paris: Société d'Éditions Géographiques, Maritimes et Coloniales, 1932.)

THIS is the first of a series of useful semi-popular volumes dealing with the land of the lemurs. It is admirably illustrated and fulfils its purpose well. One of the authors clearly has an intimate personal knowledge of the mammals, the account of which occupies nearly half the work and is illustrated by 27 plates. The invertebrates are treated very briefly, for as yet they are little known. The bibliography is particularly valuable. The French know how to write such books; they select the form in which they might lecture, bringing in all necessary scientific facts, but no others, in an attractive manner.

Elementary Physics: for Medical, First Year University Science Students and General Use in Schools. By G. Stead. Fourth edition. Pp. xiv + 457. (London: J. and A. Churchill, 1933.) 10*s*. 6*d*.

IN this, the fourth edition of the book, very few changes have been made but some additional matter has been introduced, notably in the sections on X-rays and radioactivity. Both of these, although brief, appear to be somewhat too advanced for so elementary a work. The book should be of use to medical students, for whose benefit the mathematical work has been reduced to a minimum.

Structure of Alloys*

By PROF. W. L. BRAGG, O.B.E., F.R.S.

WHEN one metal is alloyed with another, in a series of varying relative proportions, generally several new alloy structures (phases) appear which are different from each other and from the structures of either pure metal. In the usual type of diagram, the composition of the alloy is represented along a horizontal scale starting with the pure metal *A* on the left side and ending with the pure metal *B* on the right side: temperatures are plotted vertically. In a typical case, the addition of small quantities of the metal *B* to the metal *A* does not alter its characteristic structure, the atoms remaining in the same relative arrangement. Atoms of *B* replace a corresponding number of atoms of *A* in an apparently random manner, and the only observable change is a uniform contraction or expansion of the *A* lattice. There is thus a more or less extended single phase region on the left of the diagram. As the proportion of *B* is increased, a limit is reached at which the *A* structure can no longer absorb *B* atoms in this way, and beyond this point a new phase appears. The new phase, which is richer in the *B* constituent, has a different atomic arrangement, as has been confirmed by X-ray analysis. Throughout a certain range of composition the two phases co-exist and each is constant in composition, the amount of the first phase decreasing and of the second phase increasing in passing through the two-phase region from left to right. The first phase finally disappears, and a new region of single phase is entered, to be succeeded by two-phase regions and single phase regions alternately. The last single phase region on the right hand side includes as a limiting case the pure metal *B*.

Such phase diagrams have been worked out for many alloys by metallurgical methods. The boundaries between single phase and two-phase regions are determined by examining polished and etched surfaces under the microscope, and thermal and electrical measurements aid in outlining the diagram. The single phase regions are bounded on each side by lines of which the departure from the vertical shows that the extent of the phase is, to some extent, dependent upon temperature. The liquidus and solidus boundaries above each phase region show at what temperatures solidification from the melt begins and ends.

In recent years, X-ray methods have played an important part in the construction of phase diagrams, the 'powder method' being particularly suitable for this purpose. Westgren's name will always be associated with this field of inquiry, in which he was a pioneer. Several methods differing in their experimental detail have been used. In one method the alloy in the form of a fine powder is placed in a Debye-Scherrer camera, and irradiated with monochromatic X-rays of suitable wave-length. The diffracted beams form a pattern of lines upon a strip of photographic film, which is in the form of a cylinder with the powder at its axis. The pattern is characteristic of the alloy structure, and if not too complex, the structure can be completely analysed by studying the pattern it produces. In a single phase region the character of this pattern remains the same throughout the range of composition, the only change being a shift in the positions of the lines due to the expansion or contraction of the lattice. When the boundary of the single phase region is passed and the two-phase region is entered, the photographs show the pattern of both constituent phases superimposed. The lines of one become fainter, and of the other stronger, as the region is traversed. Since in this region each phase is constant in composition, the lines, though altering in intensity, do not shift their positions. If the lattice dimensions of a phase as determined by the powder photograph are plotted against composition, a sloping line is obtained in the single phase region and a horizontal line in the two-phase region. The composition at which the two lines intersect is a highly accurate index of the position of the phase boundary.

X-RAY TECHNIQUE

The wave-length of the radiation used in making the photographs must be adapted to the alloy which is being examined. It must not be absorbed too heavily by the alloy powder, both because the diffracted lines are then weak, and because the absorption implies a re-scattering of radiation in all directions with consequent darkening of the background. For example, cobalt, iron and chromium $K\alpha$ radiations are excellent for examining iron alloys, since they are of lower frequency than the iron 'absorption edge' and hence are little absorbed. A cobalt radiation gives a large absorption of cobalt $K\beta$ rays in the specimen if these waves have not previously been filtered out. Copper radiation is extremely inefficient owing to the very large absorption, which produces a blackened film on which scarcely any lines are discernible.

It is possible to obtain powder photographs which at the same time give the pattern of lines throughout the complete circle, and enable the lattice dimensions to be worked out with high accuracy. The latter are most useful indices in elaborating the phase diagram. A recent design of camera by Bradley, combined with an ingenious method of evaluating the results, enables spacings to be compared with an accuracy approaching 1/50,000 when the crystalline material is suitable, while at the same time the camera is of the ordinary circular type utilising short exposures and including the complete pattern. All 'precision methods' of measuring spacing depend upon the useful feature that rays diffracted backwards through nearly 180° enable a very accurate comparison of spacing with wave-length to be made. The particular feature of the method referred to above is the way in which errors due to incorrect placing of the specimen, absorption in the specimen, film shrinkage, and uncertainty as to camera-radius, are automatically eliminated.

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* Friday evening discourse delivered at the Royal Institution on March 17.

Powder cameras must be calibrated by taking in each camera a photograph of a crystal with known spacings. Quartz is very suitable for this purpose. It is constant in composition, has a small temperature coefficient, and gives a large number of very clear lines. The quartz photograph may become as important in X-ray work as the comparison iron spectrum in spectroscopy.

NATURE OF A 'PHASE'

The determination of phase boundaries by X-rays is merely the application of a new method to a problem already dealt with by well-established metallurgical technique. The particular contribution of X-ray analysis is its determination of the atomic arrangement in the alloy. It is found that each phase has a characteristic geometrical pattern of atomic positions. This is in accord with the findings of analysis in other crystalline bodies such as inorganic and organic compounds, but there is a new feature in alloy structures which is peculiar to them. The phase is an absolutely definite arrangement of 'sites' for atoms, if one may put it in that way, but in many cases the way in which the atoms are distributed amongst these sites turns out to be of secondary importance, and may vary widely. Such a feature is foreign to the typical inorganic or organic compound, where the atoms of various kinds have each their appointed positions.

An example of this peculiar feature is given by the structures of two closely related alloys the compositions of which approach the ideal formulæ Cu_5Zn_8 and Cu_5Cd_8. These alloys, which appear as phases in the copper-zinc and copper-cadmium systems, are obviously similar in nature. They are hard and brittle with a characteristic fracture and sheen. X-ray analysis by Bradley has determined their complex structure, in which there are 52 atoms in the unit cube, the 'γ structure'. From the similarity in atomic ratio and the correspondence in chemical properties of zinc and cadmium, it would be expected that the arrangement of zinc atoms in one and of cadmium atoms in the other would precisely correspond. The sites for atoms in the two alloys are indeed almost identical, but Bradley has been able to show that the distribution of zinc atoms amongst these sites in the one alloy is entirely different from the arrangement of cadmium atoms in the other. Clearly the peculiar complex γ structure is determined by something apart from the distribution of the atoms; the latter is a secondary feature influenced by the relative sizes of zinc and cadmium atoms.

We find similar phases, or arrangements of atomic sites, in different alloys. For example, the alloys of copper, silver, gold with metals of the *B* subgroups such as zinc, cadmium, aluminium, gallium, tin form an α face-centred cubic phase like that of copper, silver, gold themselves, a body-centred β phase, and a complex γ phase with 52 atoms in the unit cell. All γ phases have similar physical characteristics such as their extreme hardness. Since the geometrical arrangement of atomic sites in each phase appears to be quite definite, while at the same time independent of the atomic distribution, by what is it determined?

HUME-ROTHERY'S LAW

The answer to this question is provided by a brilliant hypothesis which we owe to Hume Rothery, the truth of which has now been verified by a large number of examples. Hume-Rothery's law states that each phase appears when the ratio of valency electrons to atoms has a value characteristic of that phase. For example, the β phase, which is body-centred cubic, is found when there are three valency electrons to every two atoms, examples being the alloys CuZn, Cu_3Al, Cu_5Sn. Assigning one valency electron to copper, two valency electrons to zinc, three to aluminium, and four to tin, it will be seen that in the first of these compounds there are three electrons to two atoms, in the second six electrons to four atoms, and in the third nine electrons to six atoms. An even more striking example is found amongst the γ structures to which reference has already been made. Here the electron-atom ratio is 21 : 13, examples being Cu_5Zn_8, Cu_9Al_4, $Cu_{31}Sn_8$. A hexagonal, close-packed ε structure which appears in many of the alloy systems has a ratio 7 : 4, as evidenced by $CuZn_3$, Cu_3Sn, $AgZn_3$, Ag_5Al_3, $AuCd_3$. A very large number of alloys obeying this law is now known, and it will no doubt be added to as other systems are examined.

There are exceptions to the rule. It must further be borne in mind that an alloy phase is not definite in composition but extends over a range in the phase diagram which may be broad or narrow. The composition which gives one of the above ideal electron-atom ratios may be towards one side of the single phase region, or even just outside it. It is justifiable to say, however, that the electron-atom ratio is a main factor in determining the arrangement of atomic sites in the phase. The range of the phase is modified by other factors, which make it broad or narrow and displace it one way or the other, but they are of secondary importance. Starting with copper, silver, or gold and alloying them with other metals, we run through a similar series of phases. The higher the valency of the second metal, the smaller is the amount of it which has to be added in order to produce each new phase. Quantitatively this may be expressed by saying that its contribution is to be reckoned in terms of added valency electrons, according to Hume-Rothery's law.

It is an interesting feature that the metals of the triads iron, cobalt, nickel; ruthenium, rhodium, palladium; *osmium, iridium, platinum*; form similar phases of the β and γ types. In these alloys the valency *zero* must be assigned to the transition metals; for example,

3 : 2 phase FeAl, CoAl, NiAl
21 : 13 phase Fe_5Zn_{21}, Co_5Zn_{21}, Ni_5Zn_{21}, Rh_5Zn_{21}, Pt_5Zn_{21}.

To sum up, the arrangement of atomic sites in an alloy phase appears to be due not to the interaction between the metals of one kind and those of another kind, but to the interaction between all the metal atoms on one hand, and the common electronic structure, to which they join in contributing their valency electrons, on the other hand. The metal atoms can be shuffled about between the phase-sites without a profound alteration of the nature of the phase, as if the structure were almost indifferent to the nature of the atoms in the various sites so long as they provided the quota of valency electrons. It has been shown by Bradley, for example, that ternary alloys and presumably alloys of any complexity assume the γ phase if the total electron-atom ratio is 21 : 13.

SEGREGATION OF ATOMS INTO PHASE-SITES

Two aspects of the problem of alloy structure may thus be distinguished. The first concerns the geometrical arrangement of the sites for atoms, characteristic of each type of phase. Its elucidation must be sought for in the electron-atom interaction as part of the problem of metallic structure in general. The second concerns the way in which the atoms distribute themselves amongst these sites. It has been known for some time that this distribution may vary in a given phase. On one hand, atoms of each kind may segregate into certain positions in a symmetrical way, so as to build a crystal structure of definite pattern like those found in inorganic and organic compounds. In some of the γ alloys, for example, similar atoms occupy certain sets of the sites which are related by the crystal symmetry, and the other atoms occupy the remainder.

Alternatively, we may find the formation of a *super-lattice*. In a simple β structure of the body-centred cubic type, for example, there are two atomic positions in each unit cubic cell, at corners and centres, which are crystallographically identical. In such structures as CuZn, or FeAl, one atom occupies the corners and the other the centres. In β alloys of more complex composition, however, the unit of pattern repeats in a larger distance, so that it is necessary to stack several cubes together and select symmetrically certain positions from the large unit for one of the atoms, in order to represent the unit of pattern. An X-ray photograph of such an alloy shows as a primary feature the lines due to the body-centred cubic arrangement characteristic of all β phases. In addition, subsidiary lines due to the super-lattice appear, which indicate that the unit of pattern is upon a larger scale. The segregation of the atoms into preferred positions may be followed by studying these lines.

As opposed to the formation of a super-lattice or of a regular crystalline segregation, we find in other cases that the X-ray diagram indicates merely the arrangement of the atomic sites, as if the atoms were arranged in an absolutely random manner amongst these sites. Such a random arrangement would affect the X-ray diffraction pattern as if each site were occupied by an identical unit of mean composition. Many examples might be quoted, a very striking one being given by Westgren. The alloy Cu_5Si has a complex structure in which there are twenty atoms in the unit cube. This β′ structure is assumed instead of the simple β structure by certain alloys with a 3 : 2 electron ratio, and is similar to one form of the element manganese, the β-manganese structure. An X-ray photograph of Cu_5Si gives lines identical in arrangement and relation in intensity with those of β-manganese, in which, of course, all atoms have the same scattering power, so that the scattering by each atomic site must be that of a mean effective atom. Further, it may be noted that the six atoms of Cu_5Si cannot be distributed in any regular way between twenty atomic positions, since 6 is not a factor of 20. Structures which give such an effect are said to be structures of *random replacement*.

The transition between the two extremes of regular and random replacement may be observed in one and the same alloy. Alloys at high temperatures or which have been rapidly quenched from high temperatures show random arrangement, whereas alloys subjected to prolonged annealing have a regular or super-lattice structure. The potential energy of the symmetrical structure must be less than that of the disordered structure, and hence it is the stable structure at low temperatures. At high temperatures, however, the thermal movements are causing the atoms constantly to change places, a disordered arrangement having a higher entropy than an ordered arrangement.

The study of these changes in arrangement is of great interest and importance, because they affect the physical properties of the alloy. It is to be emphasised that we are not concerned here with a phase change, since the phase remains the same throughout. We are dealing with continuous changes from order to disorder within the same phase structure.

The segregation of atoms into regular positions was surmised by Tammann in 1919 as an explanation of the changes in resistance of annealed alloys. One of the most fully examined cases is that of the gold copper alloy AuCu studied by Johannson and Linde. In this case we are dealing not only with regular and irregular distribution of atoms, but also with an alteration of crystalline form. The alloy of perfect arrangement is tetragonal in symmetry, and the symmetry passes by change of axial ratio into the cubic type as the temperature is raised. A similar but simpler case will be discussed here, where the arrangement of the atomic sites remains the same throughout. This is the case in the iron aluminium alloys examined in detail by Bradley.

The alloy of composition FeAl is a structure of the β type, with iron atoms and aluminium atoms at corners and centres of the unit cube. Iron has itself a body-centred cubic structure, and it is found that, when aluminium is dissolved in iron, there is a very wide continuous range of this body centred cubic phase extending from pure iron to FeAl. The added aluminium atoms simply replace iron atoms. Two types of super-lattice are built up. When the composition is FeAl, iron atoms at the centres of the cubes are entirely replaced by aluminium atoms, so that the structure is of the type known as a 'CsCl' structure. It may be noted that there is no crystallographic distinction between corners and centres, so that we might equally well describe the arrangement as one of aluminium atoms at corners and iron atoms at centres. When the composition is Fe_3Al, and the alloy is carefully annealed, one half of the cube centres chosen in a symmetrical way are occupied by aluminium and the other half remain iron atoms.

By observing the super-lattice lines in the photographs, Bradley has been able to follow out the process of replacement at all compositions between pure iron and FeAl. Taking first annealed alloys, the first aluminium atoms to enter the structure replace iron atoms at random. At a certain concentration, the aluminium atoms desert cube corners and one set of cube centres, and tend to concentrate in the remaining set of cube centres, finally at Fe_3Al occupying it entirely. Past this point, since one set of cube centres is now full, the further aluminium atoms start filling up the remaining set of cube centres. At a certain point, in order to equalise the distribution between the two sets of centres, these two share the available aluminium until finally at FeAl they are completely filled. The quenched alloys show a curious phenomenon. Up to 25 per cent atomic aluminium they have apparently random replacement. Past that point, within less than 1 per cent change in composition, they change over into a distribution in which all corners are occupied by iron, and centres by a random replacement of iron by aluminium.

RANDOM REPLACEMENT

When an X-ray photograph shows an apparently random replacement, are we to interpret this as meaning that the atomic sites are occupied by iron and aluminium as if they were the 'black and white balls' of a problem in probabilities? On physical grounds this is not to be expected. The Fe_3Al and FeAl structures show us that aluminium atoms under conditions of ideal equilibrium tend in the first place to avoid being nearest neighbours by segregating into cube centres, leaving the corners for iron, and further to avoid being in cubes which are side by side (Fe_3Al structure). We must postulate a slight increase in potential energy when aluminium atoms are at centres of contiguous cubes, and a larger increase when two find themselves at a corner and centre of the same cube. I am indebted to Dr. Williams for calculations concerned with this effect. If we suppose a small increase V of potential energy to be produced by one of these undesirable contacts, it is then possible to calculate the proportion of atoms in 'disorder' as opposed to 'order' at a series of temperatures.

The calculation shows that it is impossible to account for the whole range between complete order (which we know to exist by the evidence of super-lattice lines) and complete disorder, in any range of temperature experimentally available. The difference between annealing and quenching could at the most produce a slight disorder. The conditions we have set are, however, not true to actualities. As the structure becomes more disordered, the contrast between the ordered position and disordered position for a given atom becomes less, and so V must be supposed to diminish, until finally one can picture a state where no criterion is possible—the atom is completely demoralised by the corrupt state of society in which it finds itself.

It is possible, however, that what appears to be random replacement is not really a purely fortuitous distribution. We may suppose that within each small crystallite of the metal there is for the most part an ordered distribution, but that this ordered distribution is frequently getting 'out of step'. To take a simple case of a linear row, we may suppose an alternation Al-Fe-Al-Fe to take place for a part of the row, and that then owing to an excess of iron, two iron atoms follow, so that when the alternation recommences, aluminium and iron atoms have changed places. This process may be frequently repeated. Since the effects of all atoms in crystal planes are summed when the X-rays are diffracted by the crystallite as a whole, the result as regards diffraction would be an apparently random replacement of iron by aluminium. A kind of structural twinning within the crystal, which does not alter the orientation of its axes but only the succession of its atomic planes, is possible.

The behaviour of the quenched iron aluminium alloys suggests some such explanation. So long as aluminium is present in quantities less than 25 per cent in atomic proportions, there is apparent random replacement. Beyond this point the segregation suddenly appears by which aluminium goes into cube centres alone. May not this be because below 25 per cent the excess of iron causes the structure to get 'out of step', two successive layers of iron atoms causing a part of the crystallite with aluminium at centres of cubes to continue as a pattern in which the same atoms go to corners? Beyond 25 per cent aluminium, each cube must have contiguous cubes containing aluminium at centres, so that there is no question as to what is a centre and what is a corner. The plan of iron at corners and aluminium at centres is therefore carried out throughout the crystallite.

Though so many problems of alloy constitution are still to be solved, an important step forward has been made by the recognition that the arrangement of atomic sites and the segregation of atoms into these sites are separate problems, and by the discovery of similar phase-structures in alloy series of different metals. There is promise of reducing to order the vast array of hitherto uncorrelated data.

Medical Research in Great Britain

THE annual report of the Medical Research Council* again indicates the great variety of the scientific investigations carried out under its auspices with the ultimate aim of improving the health and well-being of the community. The scope of the research work initiated and aided by the Council has, as in previous years, been widened by grants from a number of public bodies interested in research work within the medical field, by the availability of university laboratories for use by investigators receiving grants from the Council, and by co-operation with Government departments and the committees of Privy Council for Industrial and Agricultural Research. The Council has exercised the strictest economy in the use of its available funds: the salaries of all its officers, and of all members of the scientific staff and whole-time grant holders have been 'cut' on the Civil Service scale. The reduction of various subsidies received from other public bodies imperilled the progress of different schemes of research, the abandonment of which, at the stage reached, would have been a very wasteful procedure. Fortunately, voluntary benefactions from private sources and notably those received from the Rockefeller Foundation and the Leverhulme Trustees prevented the setback in the work of the Council from being, it is hoped, more than temporary.

Three changes occurred in the composition of the Council during the year, Mr. W. S. Morrison, Prof. E. D. Adrian and Prof. A. E. Boycott taking the places of Major A. G. Church, Prof. R. Muir and Sir J. Herbert Parsons respectively.

The Council points out that the promotion of clinical research has always been given a primary place in its policy from the beginning of its work. The problem has been to find means of promoting the conditions in which clinical research work can be brought to its fullest development. With the co-operation of University College Hospital, London, the Council has maintained a Clinical Research Department there, with Sir Thomas Lewis as director, with charge of beds and free from all preoccupations except those of gaining new knowledge by clinical research. During the past year, the Rockefeller Foundation has generously provided a sum of money to endow in perpetuity the directorship of this Research Department, thereby releasing funds which the Council will apply to further clinical research elsewhere. The University of Aberdeen and the National Hospital for Nervous Diseases, Queen Square, London, have also shown their sympathy with clinical research: at the latter, a Research Department is in course of formation and Dr. E. A. Carmichael has been appointed by the Council as whole-time director.

The scope of the clinical work at University College has been widened. In earlier years the Department of Clinical Research dealt chiefly with cardiac problems and especially those of cardiac mechanism; more recently it has taken up problems of the peripheral blood circulation. At present, studies of hypertension and cardiac asthma are bringing problems of kidney function into view, and special attention is being paid to the symptom, pain. Interesting correlations between anginal pain and that derived from muscular ischæmia have been found.

The National Institute for Medical Research has continued the regular distribution of the standards held under the Therapeutic Substances Act, and of those held on behalf of the Health Organisation of the League of Nations. The international standards for vitamin A (carotene) and vitamin D (a solution of irradiated ergosterol in olive oil) were prepared in the Institute and together with the standard for vitamin B_1 (a dry adsorption product from an extract of rice bran prepared in Java) have now been issued for general use. Work has also been carried out on serum standards and a standard for Type 1 antipneumococcus serum has been prepared and issued. A review is at present in progress of different preparations coming under the general title of "Tubercle Vaccine", to ascertain the practical interpretation given by manufacturers to the regulations made under the Therapeutic Substances Act. The Institute also has obligations with regard to standards required by the new "British Pharmacopœia", other than those already held under the Therapeutic Substances Act, namely, those for digitalis, strophanthin and strophanthus tincture: the latter two were prepared during the year. A conference was held in London in July under the auspices of the Health Organisation of the League of Nations to discuss the possibility of establishing a uniform notation in units for the œstrus-producing hormone and eventually for other hormones for the reproductive functions. The conference recommended the adoption of a sample of the ketohydroxy form of the crystalline hormone as the international standard and entrusted the Institute with its preparation and distribution.

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* Report of the Medical Research Council for the year 1931–1932. Committee of the Privy Council for Medical Research. (London: H.M. Stationery Office, 1933.) 2s. net.

The work on canine distemper by Dr. Laidlaw and Mr. Dunkin, which was aided by the *Field* fund, has now been brought to a successful conclusion. Its progress has been described in previous reports. The whole cost of the work, spread over ten years, has been about £55,000. This has been supplied by the *Field* Fund, of which about £22,000 was contributed from British sources and £15,000 from the United States, while the rest, in services of staff, and in accommodation and other facilities, has been provided by the Council from its Parliamentary grant-in-aid. A review has been made of the results of simultaneous side-to-side inoculation with anti-serum and virus. This method appears to be rather less efficient in producing a solid and durable immunity than the original vaccine and virus method.

The usefulness of this work is not limited to the prevention and cure of canine distemper. The method of using vaccine and virus has been employed for the immunisation of man against yellow fever in West Africa and is also being used for the prevention of rinderpest among cattle in East Africa. At least one type of epidemic disease in silver fox farms appears to be due to the virus of canine distemper, and should therefore be preventable by similar means.

Work has also been continued on other virus diseases of both man and animals. In addition, a series of different bacteriophages has been subjected to critical filtration through Elford's filters. The diameter of the smallest is identical with that found for the virus of foot-and-mouth disease. The largest is stopped by a filter of such coarseness as to indicate that its particles are almost within the range of microscopical detection. The size of any one bacteriophage has been found constant and uniform independently of the nature of the bacterial organism which it attacks, and it is unchanged by purification. It appears that the bacteriophages are distinct infective agents of the nature of viruses. Confirmation is found in the fact that specific immune sera can be produced to different bacteriophages by injecting them into animals.

In concluding this brief review, it may be mentioned that the report describes, amongst numerous other investigations, work on malignant disease and nutritional problems.

News and Views

National Academy of Sciences Medal Awards

IT is announced by Science Service, Washington, D.C., that at the closing session of the meeting of the National Academy of Sciences held in Washington on April 24–26, the following medal awards were made: Alexander Agassiz medal for oceanography to Dr. Albert Defant, of the Institute for Oceanography, Berlin, for his studies on atmospheric and oceanic circulation and his notable contributions to theoretical oceanography; Public Welfare medal to Dr. William H. Park, of New York, for his work as head of the research laboratories of the New York City Department of Health as a pioneer and leader both in research and in the application of scientific discovery to the prevention of disease; John J. Carty medal and award for the advancement of science, a newly-established honour of the Academy, posthumously to the man in whose honour it was named, the late Dr. John Joseph Carty, who was noted for his accomplishments in the field of electrical engineering, particularly as they influenced the development of electrical communication; Henry Draper medal to Dr. V. M. Slipher, of the Lowell Observatory, Flagstaff, in recognition of his spectroscopic researches, which have opened up several important fields in astronomic research; Mary Clark Thompson medal to Dr. Francis Arthur Bather, formerly keeper of the Department of Geology, British Museum (Natural History), for his services in the fields of palæontology and geology.

AT the same meeting of the National Academy of Sciences, the following men of science were elected to membership of the Academy: Dr. Oswald Theodore Avery, Rockefeller Institute for Medical Research, known for his work in bacteriology; Harold Delos Babcock, physicist at the Mount Wilson Observatory, Pasadena; Dr. Thomas Barbour, curator of reptiles and amphibians at the Museum of Comparative Zoology, Harvard University; Dr. Alphonse Raymond Dochez, professor of medicine in Columbia University; Dr. Bernard Ogilvie Dodge, plant pathologist in the New York Botanical Garden; Dr. Eugene Floyd DuBois, professor of medicine in Cornell University Medical College; Prof. Griffith Conrad Evans, professor of pure mathematics in the Rice Institute, Houston, Texas; Bancroft Gherardi, vice-president of the American Telephone and Telegraph Company, New York City; Dr. Herbert Eugene Ives, physicist at the Bell Telephone Laboratories, New York City; Prof. Walter Richard Miles, professor of psychology in Yale University; Prof. Samuel Alfred Mitchell, professor of astronomy in the University of Virginia and director of the Leander McCormick Observatory of the University; Prof. Linus Pauling, professor of chemistry in the California Institute of Technology, Pasadena; Prof. Joseph Fels Ritt, professor of mathematics in Columbia University; Prof. Henry Clapp Sherman, Mitchill professor of chemistry in Columbia University.

Technical Training of the Police

LORD TRENCHARD'S recently issued annual report as Commissioner of Police of the Metropolis (Cmd. 4294. London: H.M. Stationery Office) has been received with mixed feelings. In all essentials, however, the case which has been made out for reorganisation is unassailable. The suggested formation of a police college is one of the recommendations to which exception has been taken, the grounds of objection being apparently that experience is the only training of use to the police officer. It is interesting to compare this point of view with that on the Continent. In Belgium, France and Germany, schools for the technical training of the police have been in existence for many years. In Belgium, for example, all policemen are required to take a short course at the school of scientific police. The course is designed to give the candidate an elementary grounding in the application of scientific methods to the detection of crime. More advanced courses up to the standard of a university degree are available for the higher ranks. In this respect the reorganisation advocated by Lord Trenchard will bring the system of police training closer to the Continental model. Having regard to the great advances which have been made in the application of scientific methods to the detection of crime in recent years, this is all to the good. It has been proved beyond doubt that the laboratories of the technical police can and do greatly assist the progress of criminal investigation. Apart from the practical work itself, a great deal of research work is done in these laboratories, which are specially equipped for the purpose. Absence of facilities has made this impossible in England, where very little investigation of this kind has been done. We may certainly hope that the implications of Lord Trenchard's report will become explicit in this direction and that we shall have a department for the scientific detection of crime.

Musk-Rats at the London Zoo

THE Zoological Society is indeed rendering a valuable service by putting specimens of the musk-rat on exhibition. By this means it is hoped to spread information of the grave menace which threatens large areas of Great Britain from the hosts of musk-rats which have insidiously appeared among us. It will be remembered that an article by Prof. J. Ritchie on this subject appeared in NATURE of March 18, p. 385. As was pointed out there, the musk-rat was originally introduced into Great Britain a few years ago to encourage 'fur-farming'; but the enthusiasts who entered into this scheme had no knowledge of the habits of the animals or of their amazing fecundity. As a consequence of bad-housing, many made their escape to the nearest rivers, or sheets of open water, where they remained unmolested amid ideal conditions for a considerable time, because their presence was unsuspected. It was not until railway embankments, dams, water-mills and the foundations of bridges were found to have been seriously damaged over large areas of the country, that the peril in our midst was realised. It has now been made illegal to import or keep musk-rats in Great Britain. The ill-advised introduction of the grey-squirrel has given abundant cause for repentance; but the mischief done by this pest is as nothing compared with the potential mischief which threatens from the musk-rat.

ANOTHER rodent of no little interest just added to the collection at the Gardens of the Zoological Society is the rock-cavy, or moco-cavy, of Brazil, a near relation of the guinea-pig. It is a cave-dweller, but boulder-strewn areas serve it quite as well, though even in those fastnesses it is eagerly pursued by the natives, who find its flesh delectable. In appearance it is more slender than the guinea-pig, with a long snout, and soft grey fur. A collection of humming-birds from tropical America, two of those remarkable reptiles, the egg-eating snakes, giant land-crabs from Gambia, and migratory locusts in the wingless, hopper-stage, are other additions adding still further to the attraction of the Gardens just now.

Zoological Society of London

THE report of the Zoological Society for 1932 impresses with the magnitude of the undertaking: a membership of 8,307, a visitors' list of more than a million and a half, an annual income of £130,403 and expenditure of £128,803, and a surplus of assets over liabilities amounting to £143,413. In spite of their magnitude the figures, compared with those of the past four years, show some effect of the present financial stress, but this has scarcely affected the steady progress made in the Gardens in London and at Whipsnade. The health of the animals has improved, a noteworthy record being the absence of any death from tuberculosis amongst the primates, whereas in 1926, 43 died from this disease alone. The architectural experiment of a new gorilla house of unique construction (see NATURE of May 6, p. 646) should contribute further to the health of animals admittedly difficult to keep in captivity. The position of the "Zoological Record" Fund has improved, but the loss on each volume is still much greater than the £500 per annum contributed by the Society, and societies, institutions and individuals who wish the "Record" to be maintained are requested to support the "Record Fund" by annual donations. Appeal is also made for contributions towards the maintenance of the famous herd of Chillingham Park white cattle, since a sum of £500 per annum is required to meet the rental of the Park at Chillingham Castle in Northumberland, which has been leased for seven years with the object of preserving the herd.

University of London and the British Museum

IN a correspondence between the Trustees of the British Museum and the Court of the University of London, published in the *Times* of May 18, the former body extends a cordial welcome and warm congratulations to the University on the acquisition of a home which will express its functions as a centre of humanistic and scientific research for Great Britain and the Empire. The Trustees touch on what everyone will recognise as an all-important element in the future development of teaching and research in the University, when they point to the opportunities for co-operation between the Museum and the University which will arise. In this connexion they refer more particularly to relations with the Institute of Archæology, for which a scheme is under the consideration of the University authorities. This will be a great step forward in the study of archæology in London. On one hand, the increased activity in archæological research of recent years and the need of trained men to take full advantage of the opportunities for archæological investigation which are now open in many directions, have for some time past made the need for an archæological institute, such as is contemplated, a matter of urgency. On the other hand, the efforts of the Museum to meet the varied requirements of the general public, the advanced research worker and the student in archæology, appreciated as they have been, have made an undue and unjustifiable demand on the energy and time of the staff. An earnest of future benefit to the University is already offered in the intimation that that very necessary adjunct of a practical training, a supply of cultural material, will be available for the Institute from the superabundance of the Museum.

Lower Thames Valley Deposits

A temporary exhibition is now on view in the prehistoric section of the British Museum, which includes a sequence of stone implements and flakes found by Mr. J. P. T. Burchell in the area between Swanscombe and Northfleet in North Kent. The exhibit illustrates Mr. Burchell's correlation of the industries with the glaciations of the Thames area, this involving a fresh interpretation of the events following the Boyn Hill Terrace deposits. Briefly, his contention is that following on the Boyn Hill or '100 ft.' terrace, with Clactonian I (abraded and striated), Clactonian II, Acheulean and early Mousterian, comes a period of elevation with pauses, causing terraces at progressively lower levels, in which are early Mousterian abraded implements, until Sunk Channel No. I was cut. These deposits were then sealed by glaciation and the deposit of Combe rock. Melt-water gravels then formed in the valleys and on the plateaux, which contain abraded implements of the above cultures. A period of elevation and aggradation and submergences followed, in which a thick layer of brick-earth with middle Mousterian implements was laid down over a wide area. There was then an elevation and an accumulation of sub-aerial deposits containing upper Mousterian and Aurignacian implements with coarse pottery. This was followed by a glaciation and the deposition of Trail and/or strong loam with 'rafts' of Combe rock, the equivalent of the Upper Hessle boulder clay of Yorks and East Anglia.

It will be seen that Mr. Burchell's interpretation differs from that of the geologists, who have hitherto regarded the Taplow or '50 ft.' terrace as earlier than the Combe glaciation. Archæologists and geologists alike have recognised the division of the Taplow or '50 ft.' terrace into a lower gravel with heavily rolled Acheulean and early Mousterian artefacts, as at Ealing and Hanwell, and an upper brick-earth, sealing floors containing unrolled middle Mousterian implements, as at Acton, Crayford, and Northfleet. Mr. Burchell finds that this sequence constitutes two distinct terraces separated by the glaciation responsible for the Combe rock. Capping the brick-earth is the glacial deposit known as the Trail. Among the exhibits are photographs of critical sections, as well as implements, in support of Mr. Burchell's view, as against that current in geological circles, that the Combe rock is to be equated with the Trail. This correlation is rejected by leading archæologists in the 'Handbook' of the Prehistoric Congress, 1932, p. 10. Mr. Burchell's discovery of coarse pottery in association with an upper Mousterian or Aurignacian industry is rendered less unorthodox by the evidence of Leakey from Kenya and Peyrony in France. The identification of extensive areas of brick-earth in the Swanscombe district containing shells belonging exclusively to land types seems to form a link with the upper loess of the Continent.

Physics in the Boot and Shoe Industry

The nineteenth lecture in the "Physics in Industry" series of the Institute of Physics was delivered by Mr. H. Bradley, director of the British Boot, Shoe and Allied Trades Research Association, on May 23, on "Physics in the Boot and Shoe Industry". A problem of first-rate importance in the boot and shoe industry is mensuration or anthropometry. How shall a foot be measured in order to specify concisely and accurately its shape ? The industry has hitherto relied on the eye and skill of handicraftsmen of the old school ; few of these now remain and there is need for a scientific method of foot specification. A useful start has been made on this investigation, and experiments with the most recently designed foot-measuring instrument have proved most successful. Measurements of the foot when stationary should be supplemented by a knowledge, either qualitative or quantitative, of the requirements of the foot in motion. As yet very little is known in this direction and experimental investigations were planned several years ago. The proposed experiments are closely allied with physiological studies. More about the change in conformation of the foot during walking is required. Furthermore, in the case of normally healthy feet the arches of which have not broken down, there are three main points of pressure, namely, under the heel, the inside joint or ball, and the outside joint ; it is necessary to know how the body weight is distributed among these several points of support and how this distribution changes during walking. For a material in common everyday use, leather has received little attention from physicists, particularly in Great Britain. The science of leather has developed during the past thirty years mainly on the chemical side from the point of view of its manufacture. A line of investigation into the physical properties of leather, which has been selected because there is a likelihood of its being profitable in two or three directions, is the reaction of leather to the influence of water both in the liquid and vapour state.

Alcoholic Fermentation

The twenty-second Bedson lecture was delivered on May 19, at Armstrong College, Newcastle-on-Tyne, by Prof. A. Harden, emeritus professor of biochemistry in the University of London, who took as his subject "Alcoholic Fermentation". Besides the president (Dr. R. E. Slade) and the chairman (Prof. G. R. Clemo), the past presidents, Prof. P. P. Bedson and Dr. J. T. Dunn, and Profs. H. J. Hutchens, Irvine Masson and H. L. Riley were present. Dr. Harden traced the history of the scientific investigation of fermentation from Lavoisier to Büchner and then outlined briefly but with great clarity the work of Neuberg, Meyerhof, and others as well as his own. He developed and reviewed the equations advanced for the process, discussed the rôle of the hexose mono- and diphosphates formed, and the co-enzymes required in yeast, muscle extracts, and bacteria. The fermentation processes leading to glycerol, the glycols, compounds of the butane series, lactic acid, and fumaric acid were all dealt with, as well as the energy relationships in muscle contraction with which these processes are linked. Finally, the differences between the actions of extracts and living cells were discussed.

Jubilee of the University of Oxford Junior Scientific Club

ON May 20, at the University Museum, Oxford, the Junior Scientific Club held a successful and largely-attended conversazione to celebrate the jubilee of its foundation. The Club was inaugurated in 1882 with the object of bringing together undergraduate and bachelor of arts members of the University for the discussion of scientific matters. The holding of conversaziones has always been an important part of the Club's activities, and special interest was attached to last Saturday's gathering in view of the fact that the Club has just passed the fiftieth year of its useful existence. Numerous demonstrations and exhibitions of scientific objects had been arranged by the Club, supplemented by some assistance from others. Among the features that excited most interest were a demonstration by Prof. J. G. Gray of the properties of gyroscopes, experiments with liquid air, phenomena of polarised light, series of insects, chiefly butterflies, illustrating the theory of mimicry and the phenomenon of seasonal change, and an exhibit of the results of a zoological survey of Bagley Wood. The Main Court, including the Pitt Rivers Museum of Archæology and Ethnology, was open throughout the evening; and a water-colour drawing by Bernard Gotch of the entrance to the Old Ashmolean, together with objects from the historic scientific collections there preserved were also on view. The guests of the Club were received by the president, Mr. D. H. P. Peel, of Merton College.

James Watt Memorial Institute, Birmingham

ON May 15, Mr. A. E. L. Chorlton, M.P., president of the Institution of Mechanical Engineers, opened the James Watt Memorial Institute in Great Charles Street, Birmingham, which has been provided out of the funds subscribed at the James Watt Centenary in 1919. The original scheme for which the funds were raised included both the endowment of a chair at the University of Birmingham and the erection of a building for the joint use of engineering societies. The sum subscribed, however, did not allow of the scheme being carried out in its entirety, and after establishing a research scholarship and defraying other expenses, the balance was placed in the hands of trustees, by whom the present premises have been leased and fitted up with a hall, committee room and library. In declaring the premises open, Mr. Chorlton reminded those present that the Institution of Mechanical Engineers had its birth in Birmingham and remarked that the Memorial Institute could not fail to contribute to progress by bringing engineers together for intercourse and discussion.

Alaskan Earthquake of April 26

ON the night of April 26, much damage was caused in several towns in Alaska by an earthquake. The epicentre, as determined by the U.S. Coast and Geodetic Survey, lay in Lat. 61° N., Long. 153° W., a point north-west of the Kenai Peninsula, the time at the origin being 9.36 p.m., eastern standard time. An interesting and unusual observation was made by Mr. Earl L. Williams at Gaithersburg, Md., 4,000 miles from the epicentre. While working in his observatory at about 10 p.m., he noticed that the bubble in the spirit level attached to his telescope was sliding to and fro with a slow, even motion (Science Service, Washington, D.C, April 27 and 28). Similar observations have been made in a few other earthquakes. For example, on May 9, 1877, about 74 minutes after the great Iquique earthquake, the Russian astronomer Nyren noticed unusual oscillations in the bubble of a spirit-level fixed to the transit instrument in Pulkova Observatory, more than 8,000 miles from the epicentre. Again, on April 4, 1905, after the Kangra earthquake, movements were observed in levels at Tando Masti Khan (Sind) and Thedaw (Upper Burma), which are respectively about 660 and 1,300 miles from the epicentre.

Fifth Pacific Science Congress

REFERENCE has already been made in these columns to the Fifth Pacific Science Congress to be held in Victoria and Vancouver on June 1–14 (NATURE, April 22, p. 581). From a report dated May 2 issued by the National Research Council of Canada, it appears that of 393 scientific papers received for presentation at the Congress, 131 have come from Japan, 101 have been received from the United States, fifty-six from Canada, seventeen each from China and New Zealand, eleven each from Australia and Great Britain, eight from the Netherlands Indies, four each from Hawaii, Mexico, Siam, and the Netherlands, three each from India and Peru, two each from Norway, Straits Settlement and Federated Malay States and Sweden and one each from Colombia, Denmark, Ecuador, Fiji, France, Guatemala, Philippine Islands and Spain. Arrangements are being completed whereby through the courtesy of the British Post Office, the Canadian Marconi Company, the Bell and British Columbia Telephone companies, a demonstration of a long distance wire and radio circuit will be made at the Congress and a speaker heard from Great Britain. Commdr. C. P. Edwards, Director of the Radio Branch, Department of Marine, Canada, is in charge of the demonstration.

World's Grain Conference

SIR DANIEL HALL, director of the John Innes Horticultural Institute, Merton, Surrey; Sir John Russell, director of the Rothamsted Experimental Station, Harpenden, Herts; and Prof. William Robb, director of research of the Scottish Society for Research in Plant Breeding, Corstorphine, Edinburgh, have been appointed by the Ministry of Agriculture to represent the British Government at the World's Grain Conference to be held at Regina, Canada, on July 21–August 4. At the Conference experts from all the chief grain-producing countries of the world will examine every aspect of the grain problem. The agenda provides for a thorough examination of the present trends of the world wheat position and the question of controlling production of wheat and other cereals. Another difficult problem to be faced is changes that may be necessary in the financing of the world wheat surpluses. Wheat import standards, improvements in merchandising and marketing and economy in transportation and storage will also be considered. In addition, various technical groups will discuss soils, seeds, fertilisers, pests, economics, harvesting, machinery and milling. A prominent position amongst the educational exhibits will be occupied by the display which is being arranged by the Rothamsted Experimental Station under the personal supervision of Sir John Russell. The exhibit will include sheaves of wheat from the 89th successive crop grown on the same field under varying conditions, and will demonstrate recent research into potato and other root crops in which Canada is now particularly interested.

World Petroleum Congress

THE international nature of the petroleum industry, coupled with numerous strides it has made during the last decade, make the holding of a Congress at this juncture desirable. The need for such a Congress on technical matters is unquestioned, particularly in view of the international discussions which have taken place in recent years concerning, specifically, nomenclature and methods of testing, and it was high time that an earnest endeavour was made to co-ordinate these discussions and bring about some measure of universal agreement. The Institution of Petroleum Technologists is in every way qualified to sponsor such a Congress and, since the proposal was first put forward and adopted, the organising efforts of the Committee have met with great success and encouragement. At a recent general meeting of the Institution, the arrangements for the Congress, which is to be held at the Imperial College of Science and Technology, South Kensington, S.W.7, on July 19–25, were discussed fully and a very comprehensive programme, dealing with all phases of the petroleum industry, was presented. Among the subjects to be reviewed are petroleum geology and production, oil collection, treatment, transport and measurement, hydrogenation, bituminous materials, refining problems, alternative fuels and international co-operation in standardisation. The Congress has been recognised by His Majesty's Government and delegates from various societies, institutions and committees concerned with petroleum technology all over the world have been appointed and will take an active part in the vital work scheduled for this Congress. Apart from the technical business of the Congress, there will be a government reception to the delegates, a lecture by Sir John Cadman at the Royal Institution, visits to works and laboratories of interest, exhibitions of films illustrating the petroleum industry at the Imperial Institute, a banquet at the Mayfair Hotel on July 24 and a number of social functions, which are now universally recognised as essential factors to the achievement of a full measure of success in undertakings of this character.

Atmospheric Pollution

THE eighteenth report of the Department of Scientific and Industrial Research on the "Investigation of Atmospheric Pollution" (H.M. Stationery Office, 5*s*. net) records observations for the year ending March 31, 1932. It shows that the co-operation of local authorities has been well maintained in spite of the financial difficulties of the times. Comparisons between towns on the basis of the tests, should, it is stated, be made with caution. A deposit gauge may be placed in a position where conditions are not truly representative, and it is the trend of the results over a period rather than the absolute weights of deposit which should be stressed. From this point of view there is evidence of improvement in the atmosphere of some provincial towns of Great Britain. This cannot be said of the deposit of tarry matter, which is "pre-eminently a product of domestic fires and there is little reason to think that the amount of smoke from domestic fires has decreased much in recent years". Deposits of sulphate have increased in some places, notably Ravenscourt Park, London. Such increase, it may be inferred, may be due to the increase in the sulphur content of the fuels burnt—some fuel oils are rich in sulphur—or to the concentration of fuel burning on one site, such as in large power stations. London does not show up well in the matter of smoke fog while Coventry again has an excellent record, ascribed last year to the use of gas for domestic and industrial heating.

International Illumination Congress, 1931

THE final report and statement of accounts of the International Illumination Congress, 1931, held in London and the provinces under the presidency of Mr. C. C. Paterson, has now been published. Upwards of a hundred papers, contributed from all over the world, were presented at the technical sessions in the provinces. Some of these papers contained important original matter that has led to much discussion. Donations amounting to more than £6,000 were received from industries, etc., connected with electrical engineering and £2,000 from the gas industry. Grants of £724 have been made for the development of illuminating engineering. The Committee states that the success of the Congress exceeded the most sanguine expectations.

New Journal of Experimental Agriculture

The publication of the new *Empire Journal of Experimental Agriculture* is, as the Minister of Agriculture states in his prefatory message in the first issue, "a natural and valuable development from the Imperial Agricultural Conference of 1927", for "in an Empire which fundamentally is founded on agriculture it is impossible to over-estimate the value of co-operative research work in agriculture". Furthermore, to quote the introductory message from the Secretary of State for the Dominions, it is of the utmost importance "to provide that those who are responsible for guiding agricultural policy shall keep in close touch with each other and shall quickly pool for the common advantage every new fruit of discovery and invention in the agricultural field". It is to meet these needs that the new journal has been published. The contents of the first number (April 1933) indicate that all types of problems dealing with crop or animal husbandry will lie within the scope of the journal. Subjects such as soil investigations in Canada and Cyprus, nutrition of sheep and dairy cows, animal disease, grassland management, haymaking machinery, Canadian wheat breeding and residual values of crops are dealt with, and, as an interesting contrast to the problems of to-day, an account of grain growing in Kent in the thirteenth century is included.

Announcements

At the annual general meeting of the Linnean Society of New South Wales, held on March 29, Prof. A. N. St. G. H. Burkitt, Challis professor of anatomy in the University of Sydney, was elected president for the ensuing year.

At a meeting of the Linnean Society of London, held on May 24, the following were elected foreign members: Dr. Elmer D. Merrill, director of the New York Botanical Garden; Dr. Erwin Baur, director of the Kaiser-Wilhelm Institute of Genetics, Müncheberg; Prof. Adolf Pascher, professor of botany in the German University, Prague; and Prof. Filippo Silvestri, professor of genetics and agrarian zoology, Portici. Mr. F. J. Killington and Mr. Thomas Sheppard were elected associates of the Society.

Prof. H. S. Taylor, David B. Jones professor of chemistry in Princeton University, was presented with the Mendel medal of Villanova College, Pa., U.S.A., on May 4. The Mendel medal was founded by the Augustinian fathers of Villanova College in 1928 to commemorate the well-known work of Gregor Mendel. It is awarded annually to "a Catholic who has signally advanced the cause of science". Prof. Taylor has been associated with chemistry at Princeton since 1914, and was appointed David B. Jones professor in 1927. He was made a fellow of the Royal Society in 1932, and is the author of numerous papers dealing especially with catalysis and the mechanism of chemical reaction. In collaboration with Prof. E. K. Rideal he wrote "Catalysis in Theory and Practice" and he is also the editor of a "Treatise on Physical Chemistry".

The twelfth annual conference of the Institut International de Documentation (formerly de Bibliography) will be held at Brussels on July 18–21. A series of lectures is being arranged and visits to institutions in the neighbourhood will be a feature of the programme. Further information can be obtained from the Secretary, British Society for International Bibliography, Science Library, South Kensington, London, S.W.7.

Applications are invited for the following appointments, on or before the dates mentioned:—A headmaster of the Sheffield Junior Technical School for Boys—The Secretary for Education, Education Office, Leopold Street, Sheffield (May 31). A domestic science mistress at the Polytechnic, Regent Street, London, W.1—The Director of Education (June 2). A lecturer in electrical engineering at the Kingston-upon-Hull Municipal Technical College—The Director of Education, Education Offices, Guildhall, Hull (June 3). An inspector of technical schools and colleges either in electrical engineering or chemistry (fuel technology)—The Director of Establishments, Board of Education, Whitehall, London, S.W.1 (June 3). An assistant lecturer in education at University College, Hull—The Registrar (June 9). A teacher of domestic economy (cookery and dietetics) at the Belfast Municipal College of Technology—The Principal (June 10). An assistant lecturer in physics in the University of Manchester—The Registrar (June 16). A professor of physiology at the University of Birmingham—The Secretary (June 12). An assistant lecturer in botany at the University of Bristol—The Registrar (June 17). A professor of metallurgy at the University College of South Wales and Monmouthshire, Cardiff—The Registrar (June 17). Instructor lieutenants in mathematics, science and engineering in the Royal Navy—The Adviser on Education, Admiralty, S.W.1 (July 1). Three research bacteriologists in the Medical Research Department of the Government of India; a professor of biochemistry and nutrition, a professor of malariology and rural hygiene (including venereology and tuberculosis) and a professor of vital statistics and epidemiology, and an assistant professor of public health administration, an assistant professor of biochemistry and nutrition, an assistant professor of malariology and rural hygiene (including venereology and tuberculosis), and assistant professor of vital statistics and epidemiology, at the All-India Institute of Hygiene and Public Health, Calcutta—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (July 1). A city engineer and surveyor for Capetown—Messrs. Davis and Soper, Ltd., Agents of the Corporation, 54, St. Mary Axe, E.C.3 (July 5). A research worker and a civil engineer for the Malaria Survey of India—The Secretary, Indian Research Fund Association, Simla, India (July 31). A lecturer in biology at the Stockwell Training College for Women, London, S.W.9—The Principal. An assistant in the Department of Domestic Science of Battersea Polytechnic, London, S.W.11—The Principal.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Scales of Loudness

IN the course of an extensive investigation into the measurement of noise, it became clear that the accepted standards of sensitivity of the human ear both on a basis of absolute pressure and subjective loudness needed revision. Previous work on this subject has been largely directed towards telephone conditions of listening, whereas in the more usual case of listening under 'free space' conditions, other factors such as the collecting power of the outer ear, and diffraction of the sound waves by the listener's head are involved. In order to obtain representative data, measurements have been made on 48 people of the just inaudible sound pressures at typical frequencies. All the subjects were of normal hearing and the pressures were those measured by a microphone of accurately determined field calibration in the absence of the subject. The figures given in Table I are the modes of the results and, therefore, refer to the most probable values. The subjects were chosen to represent both sexes and ages from fifteen to sixty-five years.

TABLE I

Frequency	100	200	400	800	1,600	3,200	6,400
Pressure R.M.S. Dynes/ Sq. cm.	0·0036	0·0018	0·00040	0·00023	0·00020	0·00020	0·00097

The unsatisfactory nature of the loudness scale based on the law of the logarithmic sensitivity of the ear, and conveniently embodied in the decibel scale, became obvious during experience with the method of assessing noise in terms of the intensity of an 800 cycle note which appears equally loud. By expressing the results in decibels above the threshold of audibility at 800 cycles, the figures should, by the above law, be proportional to loudness. Experience gained on the measurement of a great variety of noises shows this is not so; for example, the relation between two noises assessed in this way at 90 and 45 db. is judged by the average person to be that one is much more than "twice as loud" as the other. Since this aural comparison of loudness is so common and is, indeed, the final criterion of any scale of loudness, measurements were made on 30 people to determine what meaning, if any, could be attached to the estimate "twice as loud". The results were surprising in that, in spite of misgivings on the part of the subjects, the results were quite concordant. This result was in agreement with that obtained over a more restricted range by Ham and Parkinson[1] who also gave a reference to a paper by Richardson and Ross[2]. After preliminary measurements, the normal range of intensities at 800 cycles was covered in steps of 2 : 1, starting from 100 db., which was called 100 on the loudness scale. What is perhaps more surprising is that the curve obtained with 4 : 1 steps agreed very well with that derived from the 2 : 1 steps. Table II gives the final average figures for the relation between decibels above the threshold at 800 cycles and loudness deduced from these 2 : 1 and 4 : 1 estimates.

TABLE II

Db. above Threshold at 800 cycles	0	49	58·5	68·5	80	87·5	94·5	100	104·5	108	110
Loudness	0	5	10	20	40	60	80	100	120	140	160

An alternative loudness scale constructed as suggested by Kingsbury[3] by integrating the minimum detectable intensity changes, redetermined at 800 cycles for free space conditions, while being better than the simple decibel scale, was much less in accordance with mental estimates than the above.

To make the loudness scale apply to other frequencies the equal loudness contours determined by Kingsbury were redetermined for free space conditions, and his figures, obtained with a telephone, found to be applicable. His results were extended to 6,400 cycles and up to 100 db.

Several years' experience with the 800 cycle comparison tone method of assessing noise intensities has shown that it is most reliable, particularly for fairly steady noises, assessments by different individuals being usually to within ± 2 db. A suitable 800 cycle valve oscillator, direct reading attenuator, and single headphone have been developed in easily portable form, and this apparatus has been used to measure a great variety of noises both in the laboratory and in particular places such as streets, buildings, etc. The attenuator reads directly in decibels but the above table enables the corresponding loudness figures to be determined.

An account of the development of this apparatus and the determination of the above tables from the physical, psychological and practical points of view will be published in the near future.

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[1] *J. Ac. Soc. Am.*, April, 1932.
[2] *J. Gen. Psychol.*, April, 1930.
[3] *Phys. Rev.*, **29**, 588 ; 1927.

Diffraction of Electrons in Amorphous and in Crystalline Antimony

A THIN layer of antimony was deposited on a film of cellulose nitrate by evaporating in high vacuum. The specimen was then examined by electron diffraction in transmission. It was mounted in such a way that it could be rotated about an axis lying in the plane of the film and perpendicular to the electron beam. The following results were obtained and could be repeated at will:

When the metallic deposit is not too thick (showing weak or medium absorption of light) the diffraction pattern (Fig. 1, *a*) shows that the structure is amorphous. Numerous tests with other metals and blank films exclude the possibility that the pattern observed may be due to a cause other than the deposit of antimony.

If the deposit is very thin, the amorphous state remains absolutely unchanged for an indefinite time (at least for six months); electronic bombardment seems to have no influence. In the case of medium thickness, crystalline spots appear after some time and within a couple of hours the whole film shows a crystalline structure (Figs. 1 *b* and *c*) agreeing perfectly with the results of X-ray analysis[1]. As shown by the figures, the crystallites are not oriented at random but tend to arrange themselves so as to form a single crystal having its rhombohedral axis normal to the surface of the film[2]. Sometimes after crystallisation the amorphous state persists at the edge of the film where the thickness of the deposit is least. The crystallisation seems to set up strains in the film as it often breaks afterwards and scarcely ever before. It may be added that the deposit shows a metallic lustre in the amorphous state as well as after crystallisation.

With thick deposits (strong absorption of light) only the crystalline structure was observed. It may be pointed out, however, that in this case the films often crack some seconds or minutes after the evaporation has finished. From this it is inferred that the deposit is probably still amorphous for a short time after condensation.

I may be allowed to emphasise that in the case of Fig. 1, *a* the state should be considered as truly amorphous and not colloidal. This is based on the fact that the diffraction pattern is sensibly the same with different specimens and at different times. Crystallisation is either perfect or absent. Moreover, the diffraction pattern of the amorphous state shows little analogy with a 'broadened' powder diagram of crystalline antimony. On the other hand it agrees well with that to be expected from a packing of spherical monatomic molecules as in a liquid[3]. It is well known that in this case the 'grating constant' *d* (calculated by putting into Bragg's law the value of the diffraction angle for the first maximum) is related to the mean intermolecular distance *a* by the formula:

$$d = \alpha a$$

where α is a constant which Keesom[4] puts equal to 0·81, but which by a more rigorous treatment[3] and by considering the strong decrease of the scattering of electrons with the diffraction angle, would come out slightly higher (perhaps 0·85). As shown in the papers quoted, the value of *a* in A. is approximately:

$$a = 1{\cdot}33 \left(\frac{M}{D}\right)^{1/3}$$

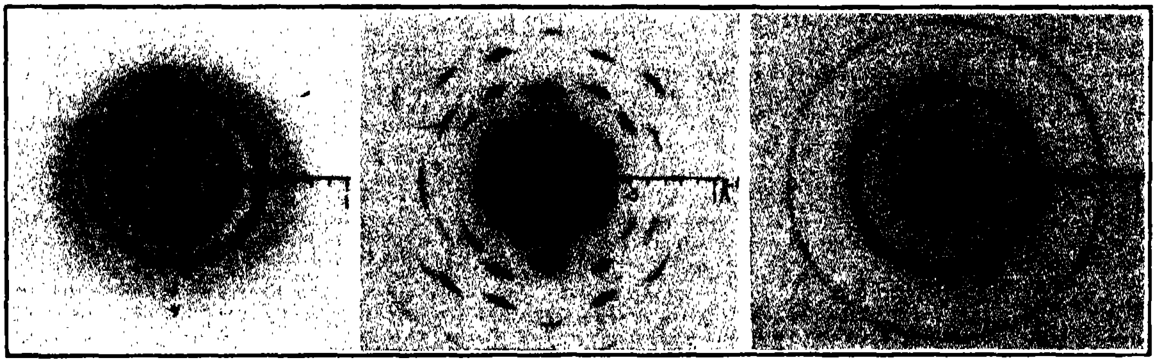
where *M* is the molecular weight, *D* the density of the substance. Now crystalline antimony has a density 6·7 and as melting does not influence the value appreciably, it seems reasonable to use the same value for our amorphous antimony. The formulæ then yield:

$$d = 0{\cdot}85 \times 3{\cdot}47 = 2{\cdot}95 \text{ A.}$$

in excellent agreement with the experimental value given below.

In the present investigation, four subsequent 'maxima' of decreasing intensity were observed. The corresponding values of d^{-1} and *d* are given below:

Maximum	1 (strong)	2 (medium)	3 (weak)	4 (weak)
d^{-1} (in A.$^{-1}$)	0·335	0·514	0·679	0·791
d (in A.)	2·99	1·94	1·47	1·26



(*a*) (*b*) (*c*)

FIG. 1. Electron diffraction patterns in antimony.

(*a*) Amorphous; $\theta = 45°$. (*b*) Crystalline; $\theta = 45°$. (*c*) Crystalline; $\theta = 0°$. Diffraction of electrons (40–50 kv.) in antimony. The normal of the film makes an angle θ with the direction of the electron beam (axis of rotation vertical). The scale indicates the reciprocal grating constants d^{-1} calculated from Bragg's law; $\lambda = 2d \sin \varphi$.

A measurement of the intensities sufficient for a calculation of the frequency curve[5] for the intermolecular distance could not be made.

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Groningen.

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[1] A. J. Bradley, *Phil. Mag.*, **47**, 657; 1924. "Strukturbericht", 59.

[2] F. Kirchner, *Naturwiss.*, **20**, 123; 1932.

[3] J. A. Prins, *Z. Phys.*, **56**, 617; 1929. *Naturwiss.*, **19**, 435; 1931.

[4] W. H. Keesom and J. de Smedt, *Proc. Roy. Soc. Amsterdam*, **25**, 118; 1922; **26**, 112; 1923.

[5] F. Zernike and J. A. Prins, *Z. Phys.*, **41**, 184; 1927. P. Debye and H. Menke, *Phys. Z.*, **31**, 797; 1930.

Influence of Light on Paramagnetic Susceptibility

THE so-called 'photomagnetic effect' was first described by Bose and Raha[1] as a decrease in the paramagnetic susceptibility of chromic chloride and of several other salts on exposure to light. Later the same authors corrected themselves[2] and claimed an increase in susceptibility followed by a slow decrease. Specchia[3,4] and Gorter[5] have also investigated the effect, the former finding a slight increase followed by a slow decrease, while the latter found only the decrease. None of these workers states the sensitivity of the apparatus used, although Specchia, who used the capillary rise method, says that water gave a deflection of 3,000 scale divisions.

I have investigated the effect in solutions of ferric chloride, chromic chloride, and neodymium nitrate by a method similar to that described by Decker[6]. In this method a small rod (test-piece) is suspended between the pole pieces of the magnet and the couple acting on it is a function of the difference in volume susceptibilities of the test-piece (K_0) and of the surrounding solution (K_1). In order to eliminate errors from variations in field intensity the test-piece was made of glass filled with gadolinium oxide so that $K_0 = K_1$. The apparatus was sensitive to 0·005 per cent, apparently about four times less sensitive than Specchia's apparatus. The light sources were a 100 watt microscope lamp, and a carbon arc. Cupric chloride solution was used to filter out the infra-red. The results obtained in every case confirmed those of Gorter; no increase was observed, but a slow decrease took place. The temperature increase due to radiation absorption was about 0·0002° per second, which was roughly that expected to cause the observed decrease in susceptibility. A marked movement of the test-piece occurred on exposure to light from which the infra-red had not been thoroughly screened off. This was doubtless due to a radiometer effect. It could be almost eliminated by making the light path strictly parallel to the test-piece.

It may be worth mentioning that the explanation of the increase in susceptibility given by Bose and Raha[7] seems to be open to the following objection. They suggest that the light causes a temporary breakdown of the l-coupling between paramagnetic ion and associated solvent molecules, thereby reducing the orbital moment damping. Such a mechanism could scarcely give rise to their observed increase of the same order of magnitude in didymium salts, as in say ferric chloride, because in the former case the $4f$ electrons which are responsible for the paramagnetism are almost completely screened from external influences, while for elements of the first transition series the orbital moments are usually strongly if not completely damped by the electrons of neighbouring ions or molecules.

P. W. SELWOOD.

Frick Chemical Laboratory,
Princeton, N.J.

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[1] Bose and Raha, NATURE, **127**, 520, April 4, 1931.
[2] Bose and Raha, NATURE, **130**, 544, Oct. 8, 1932.
[3] Specchia, NATURE, **130**, 697, Nov. 5, 1932.
[4] Specchia, *Nuovo Cimento*, N.S., **8**, 291; 1931.
[5] Gorter, NATURE, **130**, 60, July 9, 1932.
[6] Decker, *Ann. Physik.*, **79**, 324; 1926.
[7] Bose and Raha, *Z. Physik*, **80**, 361; 1933.

Supersaturation of Liquids with Gases

ALTHOUGH it is well known that liquids may be supersaturated with gases, the *extent* to which a gas may be retained in supersaturated solution does not seem to be generally realised, and no quantitative information about the phenomenon is given in most textbooks on physical chemistry.

We recently had occasion to repeat some experiments by E. C. Gilbert[1] on the oxidation of hydrazine by potassium ferricyanide, in which the course of the reaction was followed by measuring the rate at which nitrogen gas was evolved. The velocity constants obtained were much higher than those recorded by Gilbert at the same temperature and with the same initial concentrations of reagents. It was found that the rate of evolution of gas was controlled mainly by the rate of stirring, increasing with the latter up to about 1,000 r.p.m. (The rate of stirring in Gilbert's experiments was 250 r.p.m.)

That this result was due to supersaturation of the aqueous solution by the nitrogen produced in the reaction, and not to genuine variation of the reaction rate with stirring, was shown by allowing the reaction to proceed for some time in unstirred solution, and then stirring vigorously. Rapid evolution of gas occurred, and the total volume evolved soon equalled that which would have been obtained if the solution had been stirred from the beginning. In some cases the amount of nitrogen which accumulated in the unstirred solution was seven or eight times the normal solubility of the gas.

Since the course of many reactions is followed, in quantitative work on chemical kinetics, by noting the rate of evolution of a gaseous product, it is important to emphasise the fact that supersaturation, unless broken down by adequate means, is likely to invalidate completely results obtained in this way.

The extent to which supersaturation may occur in solutions saturated with gases under pressure has already been demonstrated in papers which appear to have received less attention than they deserve.

K. S. Wyatt[2] found that an aqueous solution of nitrogen, saturated at a pressure exceeding 100 atmospheres at air temperature, could be brought to atmospheric pressure without the immediate formation of bubbles in the liquid, and F. B. Kenrick, K. L. Wismer, and K. S. Wyatt[3] obtained similar results with oxygen, nitrogen and carbon dioxide. J. Metschl[4] investigated the supersaturation of water and various organic solvents with oxygen, nitrogen, hydrogen and carbon dioxide at five atmospheres pressure, and found that the resulting solutions were very stable at atmospheric pressure, vigorous agitation being required before all the excess gas could be removed. Metschl's paper contains references to earlier work on the subject, mostly of a qualitative nature.

When a solution is supersaturated with a solid, introduction of a crystal of the solid immediately induces crystallisation, but in the case of a solution supersaturated with a gas, the presence of bubbles of the gas is not similarly effective. For example, in the oxidation of hydrazine by ferricyanide, gas is slowly but continuously evolved, even when the solution is unstirred, without breaking down the supersaturation.

Further work is being carried out on this reaction.

T. N. RICHARDSON.
KENNETH C. BAILEY.

Trinity College,
Dublin.
March 28.

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[1] *J. Phys. Chem.*, **35**, 3631; 1931.
[2] *Trans. Roy. Soc. Canada*, [iii], 18, 127; 1924.
[3] *J. Phys. Chem.*, **28**, 1308; 1924.
[4] *J. Phys. Chem.*, **28**, 417; 1924.

Alkylanilines with Tertiary Alkyl Groups

THE preparation of alkylanilines containing *tertiary* alkyl groups by the reaction of *tertiary* alkyl halides with aniline is known to present serious difficulties. Thus Nef[1] obtained only a poor yield of *tertiary* butylaniline in this way and his attempts to prepare *tertiary* amylaniline furnished only an impure product. By using suitable modifications of Nef's method, it has been possible to obtain *tertiary* butylaniline, *tertiary* amylaniline and *tertiary* hexyl aniline in a state of purity.

An examination of the reactions of these amines has revealed some surprising abnormalities. The tertiary alkyl group is split off by heating the amines with aqueous mineral acids. This type of fission takes place more readily with the aryl sulphonyl derivatives of the amines. Thus while *tertiary* butylaniline is converted into aniline to the extent of 50 per cent by heating it with 15 N sulphuric acid at 120°–140° for 14 hours, the p-toluene sulphonyl derivative of *tertiary* butylaniline yields more than 90 per cent of the p-toluene sulphonyl derivative of aniline when it is heated with 15 N sulphuric acid for 1 hour at 135°–145°. The experimental evidence so far obtained indicates that the readiness with which the alkyl group is split off by the action of hot diluted sulphuric acid is in the order *tertiary* butyl $<$ *tertiary* amyl $<$ *tertiary* hexyl.

It has also been observed that the free amines do not react readily with acetic anhydride or with aryl sulphonyl chlorides. On the other hand, methyl iodide reacts with tertiary butylaniline fairly readily. Some of these reactions appear to find an explanation on the electrochemical theory recently elaborated by Robinson[2].

A detailed account will be submitted for publication elsewhere shortly.

W. J. HICKINBOTTOM.

Department of Chemistry,
University of Birmingham.

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[1] Nef, *Liebigs Annalen*, **309**, 164; 1899.

[2] Robinson, "Outline of an Electrochemical (Electronic) Theory of the Course of Organic Reactions".

Higher Homologues of Sulphur Hexafluoride

IN fractionally subliming solid sulphur hexafluoride at low temperatures, we have noticed that the last fraction liquefied before vapourising. The vapour was obtained in a fairly pure state after repeated fractionation and its density was determined with a microbalance. As fractionation proceeded, the density rose rapidly from approximately 73 (that of sulphur hexafluoride) to the neighbourhood of 125, at which it remained steady. A new sample of sulphur hexafluoride was then prepared and a further quantity of the heavy constituent obtained. Two density determinations carried out independently by each of us on different microbalances and with different samples, gave values of 126 and 129.

From these figures it is evident that the gas has a molecular weight of about 256 and is probably S_2F_{10} (molecular weight 254). During the preparation of the sulphur hexafluoride the air present in the apparatus was previously displaced by nitrogen. Hence the possibility of contamination by oxygen compounds was excluded. Moreover, the gas was allowed to stand over concentrated potash for a long period before fractionation, so that the new gas resembles sulphur hexafluoride in not being easily hydrolysed. Its boiling point is in the vicinity of 0° C. We have also obtained, in very small quantity, a volatile oil, immiscible with and unattacked by water, which may be a still higher homologue of sulphur hexafluoride.

We are proceeding to analyse these compounds and to investigate their properties.

K. G. DENBIGH.
R. WHYTLAW-GRAY.

Chemistry Department,
The University,
Leeds.
May 16.

Inheritance of Intelligence in Man

IN a recent paper[1] Dr. C. C. Hurst has discussed the inheritance of intelligence in man. After adverting to the fact that the data of Galton and Woods show that general intelligence in adults grades continuously from high to low both in general and in selected populations, Dr. Hurst finds it convenient to adopt ten grades of intelligence, because some of the data he uses is already so graded. He regards as a special *non-segregating* type those families which consist only of Grade 5 (mediocre) offspring whatever the grades of the parents, while he is content to classify as *segregating* a family of four Grade 4 (dull) offspring of parents themselves both of Grade 4.

Grade 5 is certainly peculiar, as will be seen at once from the frequency distribution of some of the data which is plotted upon permille paper in Fig. 1. The grading is stated to be equivalent to that of Galton except that the number of grades is reduced by compressing into Grade 5 six of Galton's grades, (C, B, A, a, b, c). It is just because these grades are merged into one that so many families consist only of Grade 5 offspring. These *non-segregating* families are a product of the system of grading and it is difficult to follow Dr. Hurst when he states that "the gradings are naturally imperfect . . . but, taken as a whole, the results show a general agreement which . . . signifies a close approximation to reality."

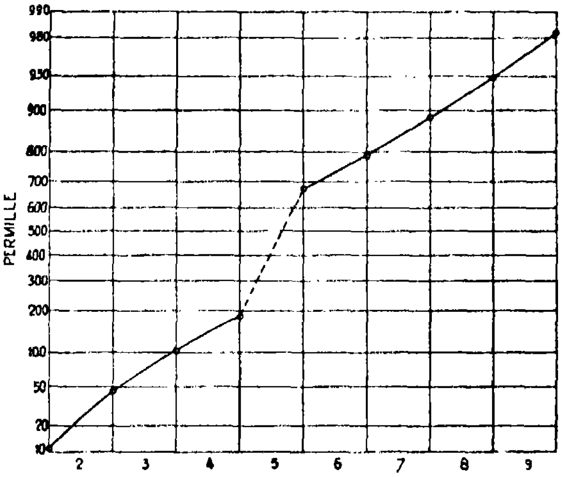

FIG. 1. Frequency distribution for R.F. data.

Dr. Hurst proceeds to develop a basic genetical formula for the inheritance of natural intelligence. This development, also, appears to be highly arbitrary, for by using three grades only a much simpler formula would surely emerge, while forty grades would yield a formula no less portentous than, and possibly quite as useful as Dr. Hurst's hexagenic one, with its 729 genotypical forms. It may perhaps be remarked that it seems somewhat lavish to postulate 729 genotypical forms in a hypothesis framed to justify ten discrete grades of intelligence.

A. F. DUFTON.

Greenbank, Garston,
Hertfordshire.
April 1.

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[1] *Proc. Roy. Soc.*, B, **112**, 80; 1932.

In placing major and minor genes on an equal footing, Mr. Dufton has failed to realise the modest rôle played by modifiers in a genetical formula. Had he worked out the formula, he would have discovered that the 729 genotypes produce only seven different kinds of effective gametes, so that the formula is not so complex as he imagines and is thus more effective in predicting the inheritance of intelligence than he realises.

The statement that the special non-segregating families have parents of any grades is obviously incorrect. Reference to Tables II, IV, VII and IX of my paper shows that each non-segregating family has a Grade 5 parent, since it is those that are being tested.

It is suggested that the non-segregating families are merely a product of the system of grading and that if mediocrity had been divided into six grades instead of one, there would have been no non-segregating families. An examination of the tables of data shows that this inference has no foundation in fact. So far as the non-segregating families are concerned, it is immaterial whether mediocrity is graded in six grades or one; the fact remains that they produce mediocrity only and no higher or lower grades of intelligence. So far as the segregating families are concerned, the grading of mediocrity in six grades would produce in Tables III, V, VI, VIII, X and XI an aberrant and abnormal frequency curve making the results unintelligible both statistically and genetically.

After many years' trials and tests in my investigations of the Leicestershire families, I found it impossible to divide mediocrity into grades with any certainty. On the other hand, it was usually easy to distinguish the adjacent higher and lower grades from mediocrity since they differed in kind rather than in degree. The intelligence quotient (*I.Q.*) tests of children carried out also confirmed this discontinuity of mediocrity. For those reasons, Woods's ten grades were adopted and his data utilised, the eleventh, grade 0, being added as a necessary sequence of the formula.

It is realised that, like other scientific formulæ, the present formula is only tentative, representing as it does the present state of knowledge. But it is basic and it is clear that no simpler formula would cover the present data. Human intelligence is not so simple a matter as Mr. Dufton would have us believe, and it is now too late to attempt to account for its inheritance on the basis of a single Mendelian difference.

The alternative suggestion that forty grades would be quite as useful, may be nearer the truth than Mr. Dufton imagines, although the facts available do not warrant such a conclusion. Further research with more refined and precise methods of grading will no doubt increase the number of grades and the number of minor genes concerned. It is doubtful, however, whether any subdivisions of the present grades would affect the basic discontinuity between stable *NN* mediocrity and *nn* higher unstable and lower grades.

Recent research indicates that more important developments may be expected from a comparative study of the modifying genes for general intelligence (Spearman's *g*) and those for the special faculties (Spearman's *s*). There is evidence, for example, that the modifiers of general intelligence (*nn*) also act as modifiers of musical ability (*mm*), and the question arises whether these same modifiers also act as modifiers of other special faculties.

C. C. Hurst.

Cambridge.
April 6.

A Possible Property of the Positive Electron

The detection of the positive electron (called positron) by Blackett and Occhialini[1] and by Anderson[2] makes it very probable that the positron has a great importance in the building up of nuclei. Anderson[2] suggests that the proton may consist of a neutron and a positron. In favour of this hypothesis we may mention the experiments of Stern (still unpublished), who found that the magnetic momentum of the proton is three times greater than it should be if the proton were to behave like an elementary particle in Dirac's theory. Following Heisenberg[3], both the proton and the neutron obey Fermi statistics and have a half integral spin momentum. This leads at once to the conclusion that, if the hypothesis of Anderson is true, the positron should obey Bose statistics and have an integral spin momentum (0 or 1). If this view should be confirmed by other experimental evidence we should understand better why the positrons can only be found in nuclei; for, since positrons have symmetrical wave functions, they can always be placed in the deepest energy levels. It seems to be an advantage of the proposed hypothesis, that contrary to Dirac's theory of 'holes'[4] an essential asymmetry between positive and negative electricity is introduced into the laws describing the behaviour of elementary particles. Since the light-quanta also have whole number momenta, it seems that it may be a general rule, that symmetrical wave functions are combined with integral momenta and anti-symmetrical wave functions with half integral momenta.

W. Elsasser.

Physikalisches Institut,
Technischen Hochschule,
Zürich. April 25.

[1] *Proc. Roy. Soc.*, **139**, 699; 1933.
[2] *Phys. Rev.*, March, 1933.
[3] *Z. Phys.*, **77**, 1; 1932.
[4] *Proc. Roy. Soc.*, **126**, 360; 1932.

Recent Magnetic Disturbances

A very notable magnetic disturbance—the greatest recorded at Stonyhurst for more than four years—occurred on April 30–May 2, the greatest movements being between noon and midnight on May 1. The 'storm', as it may fairly be called, began with a typical 'sudden commencement' at 16h. 27m. G.M.T. on April 30, when declination suddenly fell 2′ and then rose 6′, whilst horizontal force fell 36γ followed by a rapid rise of 75γ. No important movements followed until about 21h., when a 'bay' formed in both *D* and *H*, lasting about four hours, after which conditions were quiet until about 13h. on May 1, when the greatest movements began to manifest themselves, and the disturbance ended almost as abruptly as it began at about 1h. on May 2. The range in *D* was 60′ and in *HF* 436γ, ranges which have not been exceeded since 1929 Feb. 27–28.

It is noteworthy that there had been no spots on the visible hemisphere of the sun since April 21, when a small but active group, which passed the central meridian on April 20, died out. If this spot group is in any way associated with the magnetic disturbance, on the theory of emission from the sun of particles which reach the earth's atmosphere, the time of transmission of these particles, presumably emitted when the disturbed area was on or near the central meridian of the sun, would be ten or eleven days, and their velocity 175–150 km. per second.

Another recent disturbance which seems to suggest the possibility of a long-deferred activity associated with a spot group occurred in February. On that occasion the largest spot group which had appeared for more than two years, and showed considerable activity, passed the central meridian on February 7, and disappeared at the west limb on February 13, without any accompanying magnetic disturbance. Thereafter the disc was completely free from spots until February 27. On February 19, however, a very notable magnetic disturbance commenced, which for six consecutive days ranked as 'great', and for a further three days as 'moderate' in the Stonyhurst system of characterisation. In this instance the time interval between the central meridian passage of the spot group and the commencement of the magnetic disturbance was twelve days, and that to the maximum range, which occurred on February 21, was 14 days; if a physical association between the two is assumed, this would imply particle velocities of 150 km. and 125 km. per sec. respectively, which are of the same order of magnitude as those postulated in the more recent disturbance, and are moreover of the order of radial velocities which have been observed spectroscopically in prominences and dark hydrogen flocculi.

Hitherto, it has been considered that the most probable interval between the occurrence of a spot group on the central meridian and an associated magnetic storm is about one and a half days, with a range of from two days before to four days after the central meridian passage[1].

An interval of 1½ days implies a velocity of transmission of the particles of about 1,200 km. per sec., and this interval seems well established for cases in which the association of spots and storms is fairly obvious. But the possibility of an association in particular cases at much longer intervals does not appear to be ruled out, and if such an association can be proved, it might go far to clearing up much of the obscurity which still remains as to the relation between terrestrial magnetic conditions and solar phenomena. The present time, when with the approach of sunspot minimum the solar conditions are much simplified, is an eminently suitable one for carrying out such an investigation.

The problem, however, is not simple, for if it be admitted that particles with so low a velocity as, say, 120 km. per sec. may be responsible for the production of magnetic disturbances, then there seems no reason why particles with any velocity between this and the maximum attainable may not be productive of disturbance, with any interval up to 14 days between the central meridian passage of the disturbed solar area and the associated magnetic disturbance. If it is found that the length of observed interval does not vary continuously throughout its range, but tends to be grouped round certain values, there would be an indication that the particles concerned tended to have certain specific velocities, perhaps related to their size, or to the wave-lengths of light responsible for the radiation pressure to which their velocities may be attributed.

J. P. ROWLAND, S.J.

Stonyhurst College Observatory,
Nr. Blackburn.
May 9.

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[1] cf. Greaves and Newton, *Mon. Not. Roy. Ast. Soc.*, **88**, 556, and **89**, 84.

A Destructive Lightning Flash

ON Tuesday, May 9, at 3.40 p.m., a single destructive flash of lightning came to earth on my property at St. Marybourne, Andover, doing freakish damage there besides blowing very many of the electric light fuses in the village and 'blowing up' fourteen telephone boxes. The lightning struck a tree and a wire fence about 100 yards from the house but the charge of current in the local 230 volt village circuit was such that the fuses were not merely blown but those in my house made of copper 26 s.w.g. blew out the asbestos packing and deposited bright metallic copper all over the inside of the porcelain covers. A wireless set that was connected to the lighting circuit and to a well exposed aerial was not damaged at all even though there was no earth connexion to the aerial. A proper lightning guard is now in place. In my absence, the wireless set was not actually turned on; had it been, more things might have happened.

The more freakish incidents, however, occurred where the lightning actually struck. The tree struck is a black Italian poplar about 50 feet high then bursting into leaf, but there are no visible marks higher than about 20 feet. Below this there is a narrow score down one side and on the other a great area of the tree is stripped bare and the bark thrown about. The tree stands 7 feet away from a wire fence put to protect a 3-year-old quick fence from the cattle, and there is a similar wire fence 7 feet beyond. At a point 30 feet up the hill from the tree there is a laburnam straining post and about 15 feet from this post is the nearest corner of an American wind pump with galvanised iron tower and galvanised sails. This stands 35 feet high and would appear to have been an excellent route for the lightning to earth, but it was not touched. The top of the straining post where a branch of the lightning evidently struck was blown to pieces and the bits scattered for about 30 feet. This post was split down to the ground but the lightning left it at the bottom wire 18 inches above the ground and made this red-hot, burning off the zinc as far as the tree. There the strained wire broke and the lightning smashed the oak post at this point breaking it clean in half and splitting both ends. The three intermediate oak posts are undamaged except for being scorched by the red-hot wire.

At the foot of the smashed post a big flint put there to help steady it showed a mark which attracted the attention of Mr. F. H. Mackintosh, a well-known geologist, who thought it due to the lightning, and when I tried to lift the flint up the upper half came clean away from the lower half. A number of small flints also showed clean new fractures. This post, No. 4 from the start, was 7 feet from the tree and the flash dug a trench between in the turf about two feet wide and one deep, throwing the earth and sods as much as twenty feet away, and two sods were left in the tree about 12 and 15 feet up.

It so happened that my gardener, Mr. Waters, was standing at the door of the house and was looking that way at the time as he did not like the look of the cloud; he saw the earth and stones thrown up like a shell-burst and as they fell a cloud of dark smoke and steam blew away. Almost immediately after the flash there was a deluge of rain of very short duration—0·03 inch all told. This no doubt started before but was overtaken by the flash. Some of the bark was combed into a fine matted fabric and nearly black. Some of these fell 50 to 60 feet away but the short sharp wind may have helped them to travel. A second trench was dug through the quick fence to the further wire fence.

About 100 yards of the fence was badly damaged. Continuing down the hill the 9th post was broken clean through below the bottom wire but posts 5, 6, 7 and 8 were not touched, nor were posts 10, 11, 12, 14, 16, 18, 21, 22, 23. Posts 13 and 15 showed slight damage near the ground but post 17, which had been an oak gate post, was split from the top wire to the ground. Posts 19, 20, 24 and 25 showed slight damage near the ground. This fence went on another 100 yards to the river but no more posts showed any damage.

Going up the hill from the straining post much the same sequence of damaged and undamaged posts was found. Perhaps it may be worth mentioning that post No. 16, 100 feet from the straining post, had the top broken clean off and below the bottom wire the post was split open so badly that the one part was nearly free.

Only ten minutes before cows had been lying round the mill but fortunately they had been taken away to be milked.

The whole village was properly scared by the flash which seems to have been of exceptional violence, and they were expecting me to come and dig up the thunderbolt.

C. V. BOYS.

St. Marybourne,
Andover.
May 15.

Photographic Graticules

IN the annual report of the Department of Scientific and Industrial Research, 1932–1933, par. 4 on p. 111, dealing with the work of the British Scientific Instrument Research Association, gives the impression that photographic graticules were not produced in Great Britain previous to the investigation carried out by the British Scientific Instrument Research Association to which the paragraph refers. This arises as the result of certain excisions which I made for the purpose of reducing the draft drawn up by the British Scientific Instrument Research Association to a length suitable for its inclusion in the Report of the Department of Scientific and Industrial Research. I had no intention, in abbreviating the draft, of rendering it open to being read so as to convey this wrong impression.

In fairness to Mr. Julius Rheinberg, I should like to direct attention to the fact that he did great service to the optical industry during the War by developing the manufacture, by his firm, of large numbers of graticules required in instruments for Service purposes, and that his firm has been regularly supplying "grainless" and "filmless" photographic graticules since that time, though I learn that production of the latter variety has now been discontinued. I am the more sorry that the excisions should have made the paragraph capable of giving rise to the impression mentioned above since, on one occasion at my personal request, Mr. Julius Rheinberg undertook the production of graticules of a particular kind needed for a new type of instrument which had just been developed by a British manufacturer who had failed to obtain satisfactory graticules of that type from any other source.

HERBERT JACKSON.

26, Russell Square, W.C.1.

An Oestrogenic Substance from Plant Material

IN a recent communication[1] A. Butenandt mentions the identity of animal follicular hormone with the substance found by him also in plant material. In this connexion I should like to take the opportunity of presenting the results of my researches, which will appear shortly in full in the *Bulletin* of the Polish Academy of Sciences.

From 65 kgm. of the female flowers of the willow I obtained a semi-crystalline substance having a strength of 35,000 m.u. of the follicular hormone. After the further extraction of this original preparation with 60 per cent ethanol and benzene, more than 11,000 m.u. were found in the benzene fraction. From the alcoholic solution I obtained by G. Marrian's method 7·5 mgm. of crystals, the properties of which were identical with the properties of trihydroxyoestrin prepared by me from female urine. The microscopical aspect and the solubility in various solvents of the two substances were in both cases very similar; the absorption spectrum in the ultraviolet and the melting point of the acetyl derivatives (126°) being identical. By mixing crystals of the willow preparations with crystals of trihydroxyoestrin from urine (m.p. 277°) the melting point of the urine preparations was lowered only 1°.

The substances differ, however, in their biological activity, which in plant material was about 1,000 m.u. in 1 mgm., whereas in the purest preparations of trihydroxyoestrin from urine I have found the activity to be 4,000 m.u. in 1 mgm. (aqueous injections in five doses, each 0·2 c.c. in 36 hours). From the mother liquid after the crystallisation of trihydroxyoestrin, a yellow substance in the form of small particles separated, the activity of which was about 1,800 m.u. in 1 mgm. The small quantity of this substance prevented, however, its further examination.

BOLESŁAW SKARŻYŃSKI.

Institute of Medical Chemistry,
Jagellonian University,
Cracow.
April 1.

[1] *Naturwiss.*, 21, 49; 1933.

Detection of Traces of Carbon Monoxide in Air

IN NATURE for March 25 and May 6, pp. 441 and 654 respectively, it has been pointed out that carbon monoxide can be detected in air (1) in proportions of 0·015 per cent by the palladium chloride solution method, and (2) in proportions of 0·004 per cent by the Hartridge reversion spectroscope.

While palladium chloride papers have been used here to this order of accuracy, the iodine pentoxide method is used when the detection (and measurement) of still smaller proportions is required; it has been claimed[2] that 10^{-6} grams of carbon monoxide can be detected as iodine in this way. Such sensitivity has not been required here; we have, however, used this method to detect one part in 200,000 (0·0005 per cent), and find it suitable for routine use.

H. R. AMBLER.
T. C. SUTTON.

Research Department,
Woolwich.
May 8.

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[1] Ackermann, *Chem. Ztg.*, 67, 154; 1933.
[2] Tausz and Jungmann, *Gas- u. Wasserfach.*, 70, 1040; 1927.

Research Items

Burmese Spirit-World. In *Man* for April, Maung Htin Aung describes certain beliefs relating to spirits held in Burma. Spirits are of many kinds, but fall into two main divisions—the higher, which are worshipped, and the lower, which are not. The former are Buddhist, or pre-Buddhist which became semi-Buddhist on the introduction of that religion into the country, among them being 'the thirty-seven Nats'. The lower spirits have not yet been described in detail. Of them there are three kinds. The commonest, the *ah-sain-tha-yè*, are 'ghosts' which wish to hurt and frighten human beings. There are four grades, of which the lowest, the *hmin-zar*, appear in the form of small animals, darting out of the darkness. If one of these runs around a man three times completely, he will die in seven days. The *tha-hsè* appear in various forms and make noises. The *tha-yè* and the *tha-bet* do not differ greatly and are more powerful than the *tha-hsè.* They can inflict physical injury and prefer human flesh to the meat which satisfies the first two grades. Witch masters give these spirits meat regularly to have them as servants; but if they then fail to supply the meat, they are liable to be attacked. The *ót-ta-sount* guards hidden treasure, its power varying with the value of the treasure. It does not harm human beings unless they attempt to take the treasure. The *kyat* is totally harmless, and lives in holes in the ground, coming out at night to feast and laugh the whole night through. They are kindly and often entertain travellers at their feasts. All these spirits, being forms of evil, are frightened by religion and piety. When a spirit is troublesome, it may be driven away by summoning a monk to recite prayers, or a master of magic to exercise his art against it or by an offering made to the Nats, who order the spirit to leave, or by appealing to an administrative officer, who orders it not to interfere with the King's subjects on pain of exile. A spirit is powerless to disobey an order of exile from the Crown.

Mesolithic Culture in Palestine. Three communications in the *Journal of the Royal Anthropological Institute*, vol. 62, pt. 2, deal with the mesolithic period in Palestine, which was unknown before the investigations therein described. Miss Dorothy Garrod describes the excavation of the caves of Shukba and Mugharet el-Wad, Mr. Turvile Petre that of the cave of Mugharet el-Kerbarah, and Miss Dorothea Bate reports on the animal remains from the caves, in so far they throw light on the mesolithic fauna of Palestine. The stratification of the two caves excavated by Miss Garrod was much involved. In the Shukba cave the strata extended from Byzantine to Mousterian. At Mugharet el-Wad, the outer chamber showed remains of all ages to Arab times in inextricable confusion, while the inner chamber had an undisturbed sequence of four strata of upper palæolithic. The terrace of this cave, however, showed from recent to bronze overlying a mesolithic stratum with two subdivisions, which corresponded with a clearly marked typological differentiation. The evidence from the two caves points to a distinctively characterised microlithic culture, precisely like nothing previously known, and therefore distinguished by the name 'Natufian', divisible into a Lower (Mugharet el-Wad *B.*2) and an Upper (Mugharet el-Wad *B.*1 and Shukba). A tentative dating 5000–4000 B.C. is suggested. At Mugharet el-Kerbarah, Mr. Petre found a comparable culture which was particularly rich in worked bone. It resembles the Lower Natufian of Mugharet el-Wad and represents the earliest phase of Natufian yet known. Miss Bate reports that many forms well represented in the cave deposits have become much rarer or have disappeared in the modern fauna. Such are a horse, a large ox or buffalo, and the spotted hyæna. There is nothing to suggest domestication, though the Natufians were acquainted with agriculture. In Mousterian times the deer was the predominant form; by Mesolithic times the gazelle was predominant. This points to a change of climate from moist to dry and inferentially from a wooded to open country.

Reptiles and Amphibians of the Pacific Islands. In connexion with their description of the reptiles and amphibians collected in the Pacific Islands by the Whitney South Sea Expedition during the years 1920–30, Charles E. Burt and May Danheim Burt discuss the geographical relationships of the fauna (*Bull. Amer. Mus. Nat. Hist.*, 63, art. 5, Dec. 1932). The reptiles and amphibians on the islands of the Pacific Ocean are obviously derived from East Indian elements, which in turn show strong Asiatic and Australian affinities. The fauna of the South Sea Islands has been derived from New Guinean (or Papuan) elements and its eastward migration seems to have taken place through the Solomon, Banks, Santa Cruz and New Hebrides groups to New Caledonia and the Loyalty Islands in the west and to the Fiji group and points still closer to America in the east. That this distributional pathway has been made use of by the oriental fauna as a whole, is indicated by the progressive and continuous reduction in the number of species inhabiting the more distant areas. It has even resulted in a few instances in the transplantation of oriental forms into the New World. Chance dispersal has been very common in this distributional pathway, which has been determined by the linear order in which the greater land masses are arranged.

Night Migrations of *Schistomysis* and *Pseudocuma*. In a short paper ("Quantitative Studies Between the Tide Marks", *Glasgow Naturalist*, 1932) Mr. Richard Elmhirst, superintendent of the Scottish Marine Biological Station, Millport, gives some interesting information as to the abundance of some common animals of the beach. He shows that there is a set of tidal migrants which invade sandy shores after darkness. These include several amphipods, the mysid *Schistomysis spiritus* and the cumacean *Pseudocuma cercaria.* In hauls taken in February 1932 at the water's edge in a sandy bay, *Schistomysis* was found in quantities near low water at 7.30 p.m. with the moon obscured. At 5 a.m. at low water with the moon shaded there were only a few left but a large number of *Pseudocuma* had taken their place. Neither species was abundant at 10 p.m. when the moon was clear and the tide rising. Thus *Schistomysis* apparently left the shore when the moon was clear and was later replaced by *Pseudocuma.* Further hauls on different occasions show that these two species do not usually occur together but are found at different times of night or in the early morning in the same place. On the other hand, several amphipods were taken with *Pseudocuma*, especially at midnight. The proportions of the sexes were different at different times, adult females of *Schistomysis* occurring more frequently at 9 p.m. or midnight than in the early morning.

Aristogenesis. In a communication to the National Academy of Sciences, Washington, on April 25, Prof. Henry Fairfield Osborn defined the term "aristogenesis", which he had proposed at the meeting of the British Association in 1931. It is to be used as a descriptive term, without theoretical significance, and implies the orderly creation of something better or more adaptive, as observed when tracing series of fossils through successive ages. The new characters which tend towards betterment, arise independently in widely separated geographical areas, at the same or different aristogenic rates. They are definite secular changes, rather than the changes due immediately to new habit or environment which were noted by Lamarck. They were studied by Waagen in evolving series of shells of fossil mollusca, and by Osborn himself in the grinding teeth of successive fossil mammalia. The new characters which Osborn formerly named "rectigradations" may now better be termed "aristogenes". They develop more slowly than the "allometrons", or changes in the proportion of parts.

Spray Spreaders. The days belong to the past when a fungus attack was combatted by spraying infected plants with a fungicide only. Modern spray fluids contain a 'spreader' or wetting agent in addition to the fungus-destroying or insect-killing substance. A very useful survey of the various substances which can be used as spreaders and their chemical actions with some fungicides and insecticides appears in the 1932 Year Book of the Horticultural Education Association (vol. 1) entitled "The Present Uses and Future Development of Spray Spreaders" by Hubert Martin (pp. 76-84). The author deals first with the action of spreaders, and then discusses the various classes of substances used to this end. Soap was the first, and is, perhaps, still the most widely used spreader, but it is shown to have many limitations. A new method for its preparation from fatty acid and dilute alkali is described and shown to require less labour of preparation than the standard method of making a stock solution. The newer spreaders—sapamines, agrals and sulphite lye—are described and by-products from oil refinement and oils themselves can also be used. The special question of spreaders for sulphur and the new idea of using a spreader for Bordeaux mixture are also discussed. The article is of great interest to all scientific horticulturists.

Volatile Transport of Silica. In a contribution on this subject from the Geophysical Laboratory at Washington by J. W. Greig, H. E. Merwin and E. S. Shepherd (*Amer. J. Sci.*, Jan. 1933, pp. 61–73), experiments are described showing that if the volatiles that are driven off from rocks when they are heated are under a small pressure, transfer of silica through the vapour phase is brought about at an important rate. In the absence of water or other volatiles, under conditions otherwise identical, the transfer was found to be too slow to be appreciable by the methods adopted. In the experiments, which were conducted at constant temperature, silica was vapourised from the inner surface of sealed bulbs of silica glass and deposited on platinum as crystals of crystobalite. When the temperature was high, crystobalite formed a continuous crust on the inner surface of the tubes. It was found that even a small pressure of the volatiles produces a striking effect in inducing crystallisation in certain silicate liquids. This phenomenon may be applied to prepare crystals in glass for the study of equilibrium relationships in cases where it would otherwise be extremely difficult to grow crystals. The various deposits of crystobalite are described and illustrated by eight photomicrographs.

Magnetic Data and Mine Surveying. In a paper read before the Institute of Mine Surveyors (Staffordshire and Warwickshire Branch), on April 8, Mr. T. G. Bocking directed the attention of mine surveyors to certain phenomena of terrestrial magnetism which have a practical bearing on the accuracy with which precise magnetic surveying may be carried out. For accurate surveys, it is essential in the first place that the degree of magnetic disturbance occurring during the process of surveying should be known, and for the use of mining engineers, the *Colliery Guardian* and the *Iron and Coal Trades Review* publish every week tables provided by the Royal Observatory, Greenwich, and the Meteorological Office, which give, by means of appropriate symbols, a measure of the disturbance in magnetic declination as recorded at Abinger and Eskdalemuir respectively. The ideal conditions for magnetic surveying are obviously at times of little or no disturbance, and Mr. Bocking points out the possibility of forecasting favourable periods by making use of the well-known tendency of magnetic disturbance and magnetic calm to recur at intervals of about twenty-seven days, equivalent to the synodic rotation period of the sun. In 1918, Dr. C. Chree, in a paper read before the Institution of Mining Engineers, pointed out that there is decidedly more than the average chance that a day which follows about twenty-seven days after a disturbed day will show more than normal disturbance and, conversely, that a day which follows about twenty-seven days after an international 'quiet' day will show less than normal disturbance. Using the daily Abinger magnetic data, Mr. Bocking constructed a chart covering the period April, 1928–March, 1933, by arranging the daily symbols successively in horizontal rows of 27. The recurrence tendency becomes at once apparent by well-marked groupings or sequences of similar symbols. Mr. Bocking advocates that in Great Britain magnetic surveying should be carried out between 10^h and 14^h G.M.T.; during these hours his analysis shows that a small percentage only of magnetic disturbances occur and, in addition, the rate of change of the diurnal variation of declination is then usually least.

Low Temperature Research. The "Reports and Communications" made by the Kamerlingh Onnes Cryogenic Laboratory at Leyden to the First International Committee of the International Refrigeration Institute at the Sixth Congress held at Buenos Aires in the summer of 1932 have been issued as a separate volume of 460 pages by Ijdo of Leyden. Under the head of thermometry, Prof. Keesom reports that the coefficient of increase of pressure with temperature for helium has been found to be 0·0036609 by the Leyden and 0·0036606 by the Berlin observers, the normal boiling point of oxygen −182·977° and −182·965°, of hydrogen −252·754° and −252·780° C. by the two laboratories, that Leyden is not prepared to accept the international scale of the resistance thermometer as defined by the Paris agreement of 1927, that for resistance thermometry at helium temperatures a phosphor-bronze is best and that thermo-electric couples of gold with 1 per cent cobalt and silver with 1 per cent gold are most suitable. Other communications deal with vapour pressures of hydrogen and helium, specific heats, speed of sound, a bibliography of thermodynamic diagrams for refrigerants, magnetic susceptibilities, and the effects of low temperatures on organisms.

Latitude Variation of Cosmic Rays. A. H. Compton has published (*Phys. Rev.*, March 15) the results of an elaborate co-operative investigation into the geographical distribution of cosmic rays. Seven sets of ionisation chamber apparatus were constructed and measurements were made at 69 stations. The ionisation due to the cosmic rays was compared with that due to a γ-ray source, and measurements with different thicknesses of lead shielding allowed corrections to be applied for local γ-rays. The ionisation plotted against barometric pressure (including therefore both altitude and 'barometer effect') lies on a smooth curve for any one latitude, but the ionisation curves for high latitudes lie definitely above those for more equatorial regions. At sea-level the change in intensity from the highest to the lowest latitude was 14 per cent, at 4,400 metres it was 33 per cent. The change with latitude was more consistent when plotted with reference to the earth's pole of uniform magnetisation. The shape of the curves is in excellent agreement with the theory of Lemaître and Vallarta, which considers the effect of the earth's magnetic field on electrons coming from remote space, and a well fitting curve is obtained by assuming that a considerable portion of the ionisation at high latitudes is due to electrons with energy about 7×10^9 volts. It appears that the variation cannot be due to the magnetic deflection of particles within a few hundred kilometres of the earth, and it seems likely that the primary cosmic rays consist at least in part of charged particles. These experiments are apparently the first to give any systematic information about the primary cosmic rays as distinguished from the secondaries which they produce. (See also NATURE, May 20, p. 713.)

Energy Absorbed in the Cold Working of Metals. Rosenhain and Stott, working at the National Physical Laboratory, have measured the evolution of heat produced by drawing down a wire in a diamond die (*Proc. Roy. Soc.*, April). The wires were of copper and of aluminium and the drawing was carried out continuously with the die immersed in a calorimeter full of oil. The tension in the wire was measured by passing the wire to and from the die over pulleys connected to electrically-indicating spring balances. The results indicate that the heat liberated is less than that equivalent to the work performed, so that some energy becomes latent in the deformed metal. Since this energy is measured as a small difference on a rather small quantity of heat, the accuracy of measurement is not high, and the differences in the manner of working the metals make it impossible accurately to compare the values with those of other workers. The order of magnitude of the values is, however, the same as that obtained by Farren and Taylor, who used a bar stretched in a testing machine.

Astronomical Topics

Astronomical Notes for June. There is a close conjunction of Mars and Jupiter at 9 p.m. on June 4, Mars being 15′ south of Jupiter; the planets will be above the horizon in England until after midnight. On the evening of June 8 there is a conjunction of Mercury and Venus, Mercury being about a degree north of Venus. The planets will be low down, but it may be possible to observe them. Saturn may be observed in the morning hours, but its south declination of nearly 17° is a hindrance to accurate work.

The sun reaches the solstice, and summer commences, at 9 p.m. on June 21.

No occultations are visible in London under favourable conditions.

Absorption of Light in the Galaxy. Several astronomers have in recent years expressed the opinion that the amount of absorption of light by scattered matter in interstellar space is greater than that previously assumed, and in consequence that the ordinarily accepted distances of remote objects need reduction. A Science Service bulletin of April 19 gives an outline of work being carried on by Prof. Joel Stebbins and Dr. C. M. Huffer at Washburn Observatory, Madison, Wis. They conclude that there is more matter in interstellar space than that embodied in the stars themselves, and that we probably do not see even to the centre of our galaxy, much less to the farther side of it. The suggestion has already been made that the dark obscuring cloud in the Sagittarius region may hide from us the bright central region of the galaxy, which may be conjectured to exist from the analogy of the great nebula in Andromeda.

Variation of Latitude. The Cookson floating telescope, lent by Cambridge Observatory to the Royal Observatory, Greenwich, has now been in use there for three periods of seven years. The period of seven years is that in which the curve of latitude variation is expected to repeat itself, as its principal components have periods of 14 and 12 months. A large diagram, showing the variations for 21 years, is reproduced in *Monthly Notices of the Royal Astronomical Society* for March. The first seven years show the largest amplitude, attaining nearly 0·30″ in each direction. In the second period it is smaller, barely exceeding 0·20″. At the end of the second period and the beginning of the third there are four years, 1925–28, in which the variation barely reaches 0·10″. After that it revives somewhat, though not reaching the amplitude of the first period. As Sir Frank Dyson describes it: "The natural period had been damped out and a fresh start was made in the second half of 1929".

The same issue of the *Monthly Notices* contains a paper by Dr. J. C. Dobbie, investigating the effects of tidal displacements of the vertical on latitude variation. Some recent work by Dr. H. Stetson suggested that this might amount in magnitude to 0·09″, which would be an important fraction of the whole variation. Dr. Dobbie's investigation, which makes use of the Michelson-Gale experiment on tides in pipes, gives a much smaller value, barely reaching 0·01″, which is practically negligible. It is inferred that the effects noted by Stetson arise from some other cause.

Vitamin Content of Butters

BUTTER is an important source of vitamins A and D in the diet, but the amounts present vary with the feeding of the cow and also, in the case of vitamin D, with the amount of sunlight to which the animal is exposed. Summer butter is more potent than winter butter. Since much of the butter consumed in Great Britain is imported, it is essential to know whether it can compare in vitamin value with the home-produced article and whether storage has any influence upon its potency. Experiments carried out during the past few years by Crawford, Perry and Zilva on Australian, New Zealand and English butters add to our information on this subject.*

The tests were carried out on young rats: for vitamin A assays they were given a diet deficient in this vitamin, but containing irradiated hardened vegetable oil, dried yeast and lemon juice to supply vitamins D, B and C respectively. When growth had ceased, small doses of butter were given daily for four weeks and the growth rate compared with that of other animals supplied with 3–5 drops of cod liver oil daily. For vitamin D tests the animals were kept on McCollum's rachitogenic diet No. 3143: the prophylactic method was used and the positive controls were given 3–5 drops of cod liver oil daily. All the animals were killed after 28 days and the ash content of the dried fat-free bones of the hind-legs estimated. The ratio of ash to organic residue was worked out and the degree of protection from rickets expressed as a percentage of the protection given by the cod liver oil. Three doses of butter were usually employed, 0·1, 0·2 and 0·6 gm. daily, and six rats were put on each dose.

The English butters tested were obtained in winter from cows stalled but also given up to 8 oz. cod liver oil a day. 0·1 gm. daily produced about as good growth in the depleted rats as the dose of cod liver oil given to the positive controls, whilst 0·6 gm. daily gave almost complete protection from rickets. The butters were retested after 5–20 months storage at −10° to −12° C. There appeared to have been some loss of vitamin A after 20 months', but no, or only slight, loss of vitamin D after 5 months', storage.

Summer and winter butters from New Zealand and two summer butters from Australia were examined. The latter were as potent as the English butters, and the New Zealand summer butter was not significantly less active. The New Zealand winter butter, however, contained less vitamin D than the others. Storage at a low temperature for periods up to two years had little effect on the vitamin content of those butters: the New Zealand summer butter showed some loss of vitamin D in this time.

Further conclusions from this research are that the breed of the dairy herd, the district in which it is pastured, and the process of neutralising acid creams before churning, have no effect on the vitamin content of the butter from Australia and New Zealand. Butters from these Dominions therefore may be recommended to fill deficiencies in the home supply. The preface to the report states that imports from Australia and New Zealand have already increased from 20 per cent of our total imports in 1913 to 44 per cent in 1932.

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* Medical Research Council. Special Report Series, No. 175: Vitamin Content of Australian, New Zealand and English Butters. By M. E. F. Crawford, E. O. V. Perry and S. S. Zilva. (London: H.M. Stationery Office, 1932.) 1*s.* net.

University Statistics of Great Britain

THE tabular statements compiled annually by the University Grants Committee from returns submitted by universities and university colleges in Great Britain and published by H.M. Stationery Office* are models of what such publications should be—lucid, comprehensive, concise. Here is set out on twenty pages a conspectus of fifty-five institutions, comprising all important aspects susceptible of statistical presentation. The tables are preceded by a brief introductory note directing attention to some salient features of the returns with comments on their significance.

Students are classified according to sex, domicile, dwelling place (hostel, lodgings, home) during term, age on admission, grade, subjects of study, degrees and diplomas obtained. Of the total number of full-time students (35,751 men and 12,759 women) in attendance in 1931–32, approximately 23 per cent were in London, 21 per cent in Oxford and Cambridge, 21 per cent in the provincial universities of the midlands and northern England, 23 per cent in Scottish universities, 6½ per cent in Wales and 5 per cent in Bristol, Reading, Southampton and Exeter. Some 4,400, nearly 10 per cent, came from abroad, that is, from homes outside the British Isles, as did likewise 1,500 (more than 10 per cent) of the part-time students. Of these 5,900 visitors from abroad, more than half (2,609 full-time and 726 part-time) were from countries within the British Empire, whilst 1,741 full-time and 775 part-time students were foreigners. The following table gives the numbers of full-time students from abroad at those seats of learning to which they resorted in the greatest numbers and the ratios of such visitors to the total numbers of full-time students in attendance:

	(1) B.E. overseas	(2) Foreign countries	(1) and (2)	Per cent of total
London	1116	607	1723	15
Univ. Coll. ..	230	131	361	18
Sch. of Economics	133	168	301	37
Imp. Coll. ..	177	47	224	22
King's Coll. ..	121	59	180	12
Medical Schools ..	300	132	432	13
Edinburgh ..	369	182	551	15
Oxford ..	306	235	541	11
Cambridge ..	342	187	529	9
Glasgow	133	79	212	4
Manchester ..	65	68	133	5
St. Andrews ..	14	102	116	14
Birmingham ..	24	82	106	7
Leeds	65	32	97	6

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* University Grants Committee. Returns from Universities and University Colleges in Receipt of Treasury Grant. Academic Year 1931–32. Pp. 26. (London: H.M. Stationery Office, 1933.) 1*s.* 3*d.* net.

At a time when world economic problems and the quest of internationally acceptable solutions have assumed the tragic urgency of riddles of the Sphinx, it is interesting that more than a third of the London School of Economics students were from abroad and more than a fifth from foreign countries. The Imperial College (of Science and Technology) justified its name by drawing 17 per cent of its students from the outlying parts of the Empire. The number of such students at Oxford was smaller than at Cambridge, notwithstanding the imperial mission assigned to Oxford by Rhodes as the *alma mater* of the Rhodes scholars from the dominions. The large proportion of foreigners at St. Andrews and Birmingham is noticeable.

Closely associated with the question of the resort to our universities of students from abroad is the pursuit of advanced studies in them. Of the total number of full-time students 2,399 (7 per cent more than in the previous year) were engaged in research or other advanced studies and they were congregated chiefly at London (Imperial Coll. 241, Univ. 234, King's 131, School of Economics 118), Cambridge (372), Oxford (241), Edinburgh (145), Manchester (139), Birmingham (83). Part-time advanced students were numerous at London (Univ. Coll. 192, Birkbeck 178, School of Economics 99, King's 84, Univ. Coll. Hosp. Medical School 80), Liverpool (217), Glasgow (105).

University libraries are confronted everywhere at the present time with the difficulty of coping with the increasing number and cost of periodicals. The returns disclosed the fact that last year the ratio between expenditures on the purchase of periodicals and of books respectively rose from 2 : 5 to more than 3 : 5. The University Grants Committee points to the danger lest "What we may call the 'Periodicals interest' may by force of circumstances become so firmly established that it will in effect succeed in securing for itself the first call on limited library funds, and that only what is left over after its demands have been met will be available for the purchase of books proper."

University finances seem to have stood the strain of hard times well, thanks to timely limitation of commitments and concentration upon essentials, and the deficits of all the institutions, ten in number, of which the expenditure exceeded income amounted only to just over £11,000. The largest of these lapses (it was at Aberdeen) was but £3,684.

Fundamental Laws of Optical Rotatory Power

THE February issue of the *Berichte der deutschen chemischen Gesellschaft* contains an interesting account, by Dr. Werner Kuhn of Heidelberg, of a theory of optical rotatory power which he has developed with conspicuous success in recent years. A mathematical treatment of the problem has also been worked out by Dr. Kuhn and was published three years ago in the *Transactions of the Faraday Society*.

It is pointed out that in spite of the general application of the principle that optical activity is associated with structural dissymmetry, attempts to predict the magnitude or even the sign of the rotation of a new compound are singularly unsuccessful, and a more complete knowledge of the physical aspects of rotatory power seems to be necessary for a better understanding of this elusive problem. Kuhn appears to have recognised that absorption bands in the visible and ultra-violet regions constitute the physical equivalents of the asymmetric molecule of the chemist. Each of these bands furnishes a definite contribution to the rotatory power, which is the algebraic sum of all such contributions, though some of these may be negligible in value. Thus the observed rotation is in reality an additive function and each individual part of the molecule may contribute its quota.

In 1896, Cotton showed that the rotatory power of optically active compounds becomes abnormal in the region of absorption and that it is associated with circular dichroism. Now circular dichroism is caused by the unequal absorption of *d*- and *l*-circularly polarised light. Kuhn has developed this idea and has shown that a quantitative relation exists between circular dichroism and rotatory power; that is, either of these values can be calculated from the other, as illustrated by the case of chromium potassium tartrate dissolved in a solution of potassium hydroxide. Cotton investigated this solution in the visible region. In 1931 Kuhn and Szabo re-determined the values for both properties and extended their observations also into the ultra-violet region of the spectrum.

Still more striking evidence is furnished by the much more complex case of β-octyl nitrite, which Kuhn and Lehmann described in 1932. Here the curve of circular dichroism consists of several undulations and is partly positive, partly negative. From this highly complex curve a correspondingly complex curve of rotatory dispersion has been calculated and the values which are thus obtained are shown graphically to approximate very closely to experimental results.

Thus the rotatory power is the sum of the positive and negative contributions of several bands, which in the visible region are nearly but not completely balanced. Now general absorption is due to the presence in the molecule of chromophore groups, but optical rotation is not produced unless the electronic vibrations in a chromophore group are coupled with those of another group (which is probably non-absorbent or colourless), in such a way that when one vibration proceeds, say, from left to right, the other proceeds from back to front. Coupling of two vibrations in this fashion produces a difference in the absorption of *d*- and *l*-circularly polarised light and therefore dichroism, which in its turn gives rise to optical rotatory power. Thus in order that an absorption band may contribute rotatory power, it is essential that the electronic vibrations originating from a chromophore group should be capable of transmission to another part of the molecule; and the effect is greatest when this chromophore group lies near the 'centre of asymmetry'. Should these bands lie in the visible or early ultra-violet region of the spectrum, the effect on rotatory power will be very marked.

The author also deals with the vicinal effect on rotatory power of chemical changes near the absorption band. This aspect of the problem forms the subject of a separate contribution by Dr. K. Freudenberg.

University and Educational Intelligence

Cambridge.—An election to the Isaac Newton studentships will take place early in the Michaelmas Term 1933. These studentships are for the furtherance of advanced study and research in astronomy (especially gravitational astronomy, but also including the other branches of astronomy and astronomical physics) and physical optics. Those members of the University are eligible for the studentship who have obtained a degree in the University and were less than twenty-five years of age on January 1, 1933. The studentship will be of the value of £250 and will be tenable for three years. Candidates are invited to send in their applications to the Vice-Chancellor between October 10 and 16.

The Raymond Horton-Smith prize for 1931-32 has been awarded to Dr. J. E. Semple, of Corpus Christi College.

The Council of the Senate recommends that the rooms in the Forestry School when vacated by the Department of Forestry be assigned to the Department of Geography.

It is recommended by the General Board that an additional University lectureship be established in the Department of Geography, and additional University demonstratorships in the Departments of Chemistry, Physiology, and Zoology.

Dublin.—Sir Charles Arthur Kinahan Ball has been appointed Regius professor of surgery in succession to the late Sir William Taylor. Sir Arthur is a fellow of the Royal College of Surgeons in Ireland, and has been senior surgeon to Sir Patrick Dun's Hospital since 1922, as well as being honorary consulting surgeon to several other institutions in Ireland.

Mr. John Purser has been appointed professor of civil engineering in succession to Prof. David Clark. Mr. Purser is assistant professor of civil engineering in the City and Guilds (Engineering) College, and reader in civil engineering in the University of London.

Leeds.—Dr. W. MacAdam has been elected to the chair of clinical medicine as from the beginning of next session and Dr. R. H. Evans has been appointed lecturer in civil engineering.

It has been decided to institute a part-time course in biology leading to a diploma. The course will occupy six hours a week (three hours in the evening and three on Saturday morning) and will extend over two sessions. It is designed particularly to meet the needs of teachers who want a qualification in this subject.

The University Council has accepted most gratefully from Mrs. Graham of Headingley a gift of £1,200 for the endowment of a scholarship in memory of her husband, Dr. James Graham, who was for twenty-five years director of education in the city of Leeds. The scholarship will be open to candidates whose parents live or have lived in Leeds, and who have attended an elementary or secondary school in Leeds for at least three years, provided that they have passed either the matriculation or the Higher School Certificate examination prior to enrolment at the University. Preference will be given to a candidate desiring to proceed to a degree in commerce.

London.—Mr. C. A. Mace, since 1930 head of the Department of Experimental Psychology in the University of St. Andrews, has been appointed University reader in psychology (Bedford College).

The title of University reader has been conferred on the following in respect of posts held at the Colleges indicated: biochemistry, Dr. Katharine H. Coward (College of the Pharmaceutical Society); chemistry, Dr. David C. Jones (East London College), and Mr. Bryan Topley (University College).

The Dunn exhibitions in anatomy and physiology for 1933 have been awarded respectively to Mr. J. C. B. Bone (Middlesex Hospital Medical School) and Mr. J. S. Horn (University College).

Manchester.—Prof. I. M. Heilbron has accepted an invitation to a chair of organic chemistry in the University. Prof. Heilbron was born in Glasgow, and received his early education in that city at the High School and the Royal Technical College, of which institution he was a lecturer from 1909 until 1914, and, after the War, professor of organic chemistry. He was appointed to the Heath Harrison chair of organic chemistry in the University of Liverpool in 1920, and has held that post to the present date. He is known for his researches on natural products, especially fish liver oils, fat soluble vitamins, cholesterol and other sterols, and was elected to a fellowship of the Royal Society in 1931.

Dr. John Prescott, lecturer since 1905, and, since 1922, head of the Department of Mathematics in the College of Technology, retires at the end of the present session. Mr. James Winterbottom, director of spinning in the College of Technology, also retires; he has been on the staff of the College since 1894.

Dr. R. W. Gurney, at present assistant lecturer in physics in the University, has been appointed research fellow in the University of Bristol.

Reading.—The Council of the University has appointed Mr. R. Rae to be professor of agriculture in succession to Prof. S. Pennington, who retires in September. Mr. Rae is at present professor of crop and animal husbandry in the Queen's University, Belfast.

The twenty-fourth Conference of the Association of Teachers in Technical Institutions is to be held at Lincoln on June 3–6. All meetings will be in the Technical College. The arrangements have been in the hands of a committee of the Association's Leicester Branch (Joint Hon. Conference Secretaries—Messrs. T. E. Hartley, and M. Brewitt, Technical College, Lincoln). The first public meeting will be held on June 5, when the Conference will be officially welcomed by the Mayor of Lincoln (Alderman J. W. Rayment), and the retiring president, Mr. S. H. Moorfield (Mining and Technical College, Wigan), will induct the president for 1933–34, Mr. F. H. Reid (Technical College, Paddington). Resolutions on the following topics, among others, will be discussed by the Conference: regional co-ordination of technical education; increase in number of technical institutions and extensions; education and industry; junior instruction and junior unemployment centres; closure of junior technical schools; recruitment for industry. An exhibition of books and apparatus will be held in the Technical College during the Conference.

Calendar of Nature Topics

Persia, "Wind of 120 Days"

In the Persian province of Seistan a violent wind from between north-west and north-north-west sets in every year about the end of May or early in June and blows almost without cessation until about the end of September. From its duration it is known as the "Bad-i-sad-o-bist roz" or "wind of 120 days". It sometimes reaches a velocity of more than 70 miles an hour, and carries a great quantity of sand and dust, which have remarkable effects. In some places the whole land surface is eroded, and old buildings are eaten away and undercut near the ground. Elsewhere the sand is deposited in wandering dunes, which overwhelm villages and choke water-supplies. All buildings, both ancient and modern, are built with blank walls on the windward side; this wind appears to have been a regular feature of the climate of Seistan since early historic times.

The Cuckoo's Call

"On the first of June
The Cuckoo changes her tune."

It has been suggested that the change referred to in the old rhyme is the singing of a triple instead of the usual double note, but this is probably an individual peculiarity, since there are birds also which can sing only *cuck*. It is more likely that the reference is to a change which takes place in the tune itself. In the spring, the cuckoo begins singing with an interval of a minor third; about June, it is said to proceed to a major third; and later to a major fourth, then a fifth, after which its voice breaks before reaching a minor sixth.

"Der Kuckuck drauf anfing geschwind
Kuckuck! sein'n G'sang durch Terz, Quart, Quint."

The cuckoo's note itself has given trouble to the recorders. Gilbert White's neighbour, "who is said to have a nice ear", found that it varied in different individuals; "for about Selbourne wood, he found they were mostly in D; he heard two sing together, the one in D, and the other in D sharp, which made a disagreeable concert." Some he heard in C. Hoffmann says that the German folksongs mostly pitch the song in G major, which makes the song too deep. The English rhyme quoted above attributes the song to the female bird, but although the female sings and is even said to have a call of her own, the male is the most persistent caller.

Display of Sage Grouse

Amongst the many remarkable displays of birds, associated with the courting season, one of the most striking is that of the sage grouse (*Centrocercus urophasianus*), a native of the sage-brush region of western North America from southern British Columbia to New Mexico. In Oregon, R. Bruce Horsfall found the cocks assembling on May mornings by the shore of Klamath Lake, strutting with puffed-out chests and spread tails, and making noises which reminded him of the popping of corks on the pier at Atlantic City (this was in 1918). The strut was made up of four movements. First, the filling of air sacs enormously expanded the throat pouch to the accompaniment of a grunting sound; second, a short stiff-legged run was made with neither pouch nor wings touching the ground; *third*, the bird stopped suddenly, spread his tail and pushed forward his wings so as to raise the air pouch well up on the chest; fourth, a sudden upward throw caused the air pouch to rise and descend upon the chest with a rubbery 'plop', which was repeated three times before the whole performance recommenced (*Zoologica*, 2, 243; 1920). As many as sixty sage cocks were seen displaying at intervals of twenty-five to fifty feet, for each bird appeared to have a select territory on which no other dared to trespass with impunity. The display was not altogether a courting action, because when hens wandered through the throng during the performance, no notice was ever taken of them.

Barracuda Fisheries

During the month of May, the Barracuda fishery of California, which for six months supplies the markets of Los Angeles, reaches its height. Occasional fish may appear in winter, but the appearance of shoals occurs about mid-March, and after the May maximum the catch tails away, having furnished some 3½ million pounds of fish flesh in about six months. For the remaining six months a catch of about two million pounds from Mexico stocks the markets. The barracuda (*Sphyræna argentea*) belongs to a group of fishes represented in tropical waters throughout the world, but little has been known until now about their habits and life-histories. The importance of the American and Mexican fisheries, however, has led to a thorough investigation of the Californian species, and the results have recently appeared from the Division of Fish and Game of California as *Fish Bulletin No. 37* (1932), by Lionel A. Walford. The spawning period begins in April, reaches its climax in June and ends in September, and the number of eggs laid depends upon the size of the fish, a two-year old of 50 cm. length containing about 50,000 eggs, a seven-year old of 91 cm. about 340,000 eggs. The fish may attain an age of at least eleven years. An analysis of the catch-records in relation to fertility suggests that the present legal limit of three pounds should be replaced by a limit of not less than 30 in. length.

Summer Thermocline in Seas and Lakes

Solar radiation is absorbed by the surface waters in lakes and seas causing them to become warmer and lighter than the water beneath. In temperate climates, during a quiet summer, heating of the surface warm layer may continue and by August a difference of as much as 7° C. may be found between the surface and the twenty-five metre layers. There is often an abrupt transition between these warm and cold layers, often called the thermocline or discontinuity layer. This may occur at about twenty metres in the English Channel, first becoming evident usually in May, and at between forty and fifty metres in the Barents Sea. The thermocline may be broken down by a period of stormy weather resulting in a uniform distribution of temperature down to a considerable depth. Due to this mixing, in a shallow sea, sunless stormy weather may lead to high bottom temperatures, whereas in a sunny, quiet year with high surface temperature, the bottom temperatures will be low. Although often left out of consideration, this is probably a factor of importance in the distribution of animals and plants in different seasons.

Societies and Academies

London

Royal Society, May 18. W. T. Calman and Isabella Gordon : A dodecapodous pycnogonid. *Dodecolopoda mawsoni*, a new species representing a new genus of Pycnogonida, is described. It was obtained by Sir Douglas Mawson in the antarctic, and has the remarkable peculiarity of possessing six leg-bearing somites. It is suggested that the ten-legged and twelve-legged Pycnogonida originated by the development of instability in the metameric pattern of octopodous forms ; also that the Pycnogonida as a whole may owe their origin to an analogous disturbance of the cephalic metamerism of normal Arachnida (see also Nature, 131, 242, Feb. 18, 1933). J. Gray : Directional control of fish movements. In all the fish examined, a change in the direction of motion is effected by propagating an abnormally large wave of muscular contraction down the side of the body towards which the animal turns. During the first phase of the movement the anterior end of the fish turns on the posterior end, which remains relatively stationary in position. During the final phase of the movement the posterior end of the body moves towards the new axis of movement and during this process the anterior end of the animal remains relatively stationary. Except for fish with long and flexible bodies, the caudal fin plays an essential rôle during turning movements for it enables the posterior end of the body to act as a fulcrum on which the head is able to move through the water. A typical pelagic fish such as a whiting can turn through 180° within a circle the diameter of which is not greater than the length of the whole fish.

Paris

Academy of Sciences, April 10 (*C.R.*, **196**, 1057–1152). Jules Drach : The congruences of right lines and their focal surfaces. Charles Richet : An aerofilter for the purification of air. Remarks on a recent note on this subject by Gaston Meniér and recalling an apparatus described in 1909 achieving the same object. Serge Bernstein : The Fokker-Planck differential equation. M. Gignoux and L. Moret : The internal structural units of the Alpine chain between the Pelvoux and Durance. J. Mirguet : Certain ensembles of right lines. Paul Mentré : A projective deformation of tetrahedral complexes. Antoine Appert : Orders of separability in abstract spaces. D. van Dantzig : Monobolic groups and nearly periodic functions. Juan Carlos Vignaux : The method of summation of Edouard Le Roy. E. Kogbetliantz : The approximate expression of the Laguerre polynomial $L_n^{(\alpha)}(x)$. Michel Luntz and Paul Schwarz : Coaxial annular alternate vortices and some phenomena of asymmetry relating to the rotation of a cylinder in a viscous fluid. Max Serruys : An optical manograph with small inertia. G. Lemaître : The formation of nebulæ in the universe in expansion. E. M. Antoniadi : Some changes recently observed on the planet Mars with the 83 cm. telescope of the Meudon Observatory. Léon Brillouin : How can supraconductivity be interpreted ? A. Pérard : The elimination of the error of parallax in precision thermometers. Lew Kowarski : The movement of liquid drops in growing crystals. Contribution to the study of the intermediate state between a crystal and its sublimed vapour. Henri Abraham : The laws of action at a distance in electricity. G. Allard : The calculation of electric moments. R. Forrer : Interatomic electrons in crystalline networks. A. Sesmat : A new form of Michelson's experiment. G. A. Boutry : A precision densitometer with a photoelectric cell. Pierre Auger and Gabriel Monod-Herzen : Collisions between neutrons and protons. Mme. Irène Curie and F. Joliot : Contribution to the study of the positive electron. Mlle. C. Chamié : The expansion of the atoms of radioactive recoil in air. Henri Muller : The lowering of the eutectic point in the case of a ternary eutectic. F. Bourion and E. Rouyer : The cryoscopic determination of the total hydration of the ions of potassium chloride. René Wolff : Electrochemical phenomena of the catalytic decomposition of hydrogen peroxide by platinum. J. Barlot : A new method of analysis of bituminous schists. The mineral matter is removed by treatment with hydrofluoric acid. A study of the bituminous schist from the Creveney basin leads the author to the conclusion that this is not an impregnated rock like petroliferous sands, but a mother rock, possibly the fundamental mother rock of petroleum. Mme. G. Allard : The refractometric determination of organic acids. Mlle. B. Gredy : The acetylene linkage. The study of some bisubstituted acetylene hydrocarbons. Details of the Raman spectra of eleven bisubstituted acetylenes : all show two lines of unequal intensity in the region 2200–2300 cm.$^{-1}$. Jean Amiel : The slow combustion of benzene. A mixture of the composition $C_6H_6 + 15O$ under an initial pressure of one atmosphere was heated at temperatures between 400° C. and 540° C. The experimental results are given graphically. J. A. Gautier : *N*–Hydroxyethyl–α–pyridone and some of its derivatives. F. Kayser : The two diastereoisomeric 1.2.3–triphenyl–1–propanols. The exclusive preparation of each of them starting with the oxides of stilbene and isostilbene. Charles Prévost : An iodo-silver-benzoic complex and its application to the oxidation of ethylene compounds into α-glycols. A solution of iodine in benzene reacts with silver benzoate giving a compound $(C_6H_5.CO_2)_2AgI$ which can be crystallised from hot benzene. This reacts with ethylene derivatives giving good yields of the corresponding glycol benzoates. J. Barthoux : Lapis lazuli and balas rubies of the Afghan cipolins. Mlle. E. David : The Oligocene and Burdigalian of northern Syria. P. Corbin and N. Oulianoff : The inclination of the granite sheets in the Mont Blanc massif. James Basset, Mme. E. Wollman, M. A. Machebœuf and M. Bardach : Studies on the biological effects of ultra-pressures. The action of very high pressures on bacteriophages and on an invisible virus (vaccine virus). The resistance to pressure of the bacteriophages is of the same order as that of vaccine virus and much less than that of the diastases and toxins previously studied. E. Roubaud : Desert anhydrobiosis and its influence on the animal cycle of *Schistocerca peregrina*. Preserved in air of low humidity, the winged locusts remain in an immature state and their normal manifestations of reproductive activity are retarded. Placed in moist air, sexual activity is recovered in a few days. H. Bordier : Merget's phenomenon may be produced by the vaporisation of solid bodies. Mme. Y. Khouvine : The synthesis of cellulose by *Acetobacter xylinum* starting from mannite and sorbite. Michel Polonovski, Paul Boulanger and Gaston Bizard :

Pancreatic ammoniophaneresis. A. Jellinek: Measurements of temperatures in the interior of an egg placed in the electric field of ultra-short waves.

ROME

Royal National Academy of the Lincei, Dec. 18. E. Almansi: Deformations of elastic strips (2). G. Ascoli: The conditions for the validity of Taylor's development in the real field. D. Bonvicini: Non-infinitesimal deformations. M. Kourensky: The integration of the equations to the partial derivatives of the second order with two functions of two independent variables (4). Systems containing three derivatives of the second order. G. Mammana: The numerical solution of a system of equations. Maria Pastori: Tensorial assemblages generated by Pascal-Vitali absolute systems. F. Zagar: The increase in mass of a planet by the effect of cosmic dust (1). Premises and a particular case. In Levi-Cività's treatment of this question, the translatory motion of the planet as a material point is considered. For the case in which only the surface elements are struck by the dust, while the internal points retain their mass unchanged, the general expressions are now deduced and a particular case is discussed. G. R. Levi and D. Ghiron: Magnesium chlorite and double chlorites of copper with magnesium, barium, and thallium. Magnesium chlorite, $Mg(ClO_2)_2$, $6H_2O$, obtained by double decomposition from concentrated solutions of barium chlorite and magnesium sulphate, followed by slow evaporation in the dark, forms pseudocubic, rhombohedric, colourless crystals having the density 1·62 and the axial ratio $c : a = 2{\cdot}45$. The following double chlorites have also been prepared: $2\,Cu\,(ClO_2)_2$, $Mg\,(ClO_2)_2$, $8H_2O$, in brown crystals appearing yellow in transmitted light; $Cu\,(ClO_2)_2$, $Ba\,(ClO_2)_2$, $4H_2O$, in yellow crystals showing green fluorescence; $Cu\,(ClO_2)_2$, $Tl\,ClO_2$, $2H_2O$, as a reddish-brown, crystalline powder. These double chlorites are markedly more stable than copper chlorite itself. A. Fabris: The absorptive power of soil for pyrophosphoric acid. It has been already found that pyrophosphates take part in the transformation cycle of phosphoric acid in the soil and in the phosphatic nutrition of plants. Experiments made with soils of different characters show that these are capable of fixing the pyrophosphoric ion from solutions of pyrophosphates. This absorptive power is shown in greatest degree by the organic constituents of the soil. Under the experimental conditions employed, the absorption from $0{\cdot}1\,N$ solutions reaches its maximum intensity in about twenty-four hours, whereas with more dilute solutions ($0{\cdot}01\,N$) the maximum occurs after a few minutes. The phenomenon exhibits the characters of a typical colloidal absorption effect. T. Carpanese: The mineral deposits of Monte Rosso di Verra (Monte Rosa group). As a conclusion to a series of investigations on the minerals occurring in these deposits, the results of a study of the rocks and of the mineralogical paragenesis of the deposits are given. F. Rodolico: The water in the tremolites of Monte Spinosa in the Campigliese. Debye-Scherrer photograms of Monte Spinosa tremolite, before and after dehydration, are not superposable and show marked differences in both the position and the intensity of the interference lines. The results obtained up to the present indicate that the water in this mineral must be regarded as water of constitution.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 19, 1–207, Jan. 15, 1933)*. W. E. Castle and C. E. Keeler: (1) Blood group inheritance in the rabbit. Only two agglutinogens were found in the blood of rabbits and they are inherited as Mendelian dominants, probably different allelomorphs of the same autosomal gene. (2) Tests for linkage between the blood-group genes and other known genes of the rabbit. No linkage has been found with five of the eight known gene-bearing chromosomes. C. D. Darlington: The behaviour of interchange heterozygotes in *Œnothera*. A. Dorothy Bergner, S. Satina and A. F. Blakeslee: Prime types in *Datura*. 'Prime' types are races with modified chromosomes and they are useful for testing. A. F. Blakeslee, A. Dorothy Bergner and Amos G. Avery: Methods of synthesising pure-breeding types with predicted characters in the Jimson weed, *Datura stramonium*. 'Prime' types are used as a source of modified chromosomes. John W. Gowen and E. H. Gay: Eversporting as a function of the *Y*-chromosome in *Drosophila melanogaster*. Preston E. James: The higher crystalline plateau of south-eastern Brazil. Ernst Cloos: Structure of the "Ellicott City granite", Maryland. Lincoln Dryden: Xenohelix in the Maryland Miocene. The term 'Xenhelix' has been given by Mansfield to large corkscrew-like structures found in the St. Mary's formation of Maryland. Similar structures are also found in the Culvert formation. They appear to be animal borings made by soft-bodied forms, always associated with a definite unconformable surface. Arthur E. Kennelly: Conference of the Symbols, Units and Nomenclature (S.U.N.) Commission of the International Union of Pure and Applied Physics (I.P.U.) at Paris, in July, 1932, and its results. A historical outline of the C.G.S. units and an unofficial summary of the results of the above meeting. John F. Shepard: Higher processes in the behaviour of rats. Rats differed considerably in ability to learn a maze. T. H. Chang, R. W. Gerard and M. Shaffer: The *in vitro* respiration of nerve. The increased respiration of nerves in serum and delayed rise in oxygen consumption is due to bacteria. Robert Gesell and Carl Moyer: Observations on the nervous control of respiratory movements. Eugene U. Still: On the metabolism of the pancreas. Oxygen consumption and carbon dioxide contents of venous blood from the gland were measured. Rudolf Ruedemann: Palæozoic planktonic faunas of North America. A planktonic fauna corresponding with that of the present Sargasso Sea is found associated with graptolites in the typical graptolite shales. Its distribution suggests 'Sargasso seas' east and west of North America in the Palæozoic Atlantic and Pacific Oceans and, in consequence, the very early existence of these oceans. Henry Fairfield Osborn: Biological inductions from the evolution of the Proboscidea. The fundamental principle of evolution is germinal stability, adaptive biomechanical variation of the germ plasm being merely secular. The term aristogenesis is given to this germinally predetermined evolution always tending toward improvement. Recent palæontological work on proboscidean teeth gives further support to the hypothesis. A. Franklin Shull: The time of embryonic segregation in aphids as determined from intermediate types. The change from gamic to parthenogenetic individuals is marked by a definite series of changes; the direction of this series should give two complementary series. Three quarters of the intermediate types produced support the 'time of determination' hypothesis. G. H. Parker: The cellular transmission of neurohumoral substances in melanophore reactions. The denervated area on the tail of a chub shows very slow response to background changes. It is suggested that the cellular transmission this indicates is the primitive mode. William Beebe: Preliminary account of deep sea dives in the bathysphere with especial reference to one of 2,200 feet. The pressure and temperature outside the bathysphere were 993·7 lb. per sq. in. and 53° F.; the total pressure on the bathysphere was 5,120 tons. The eye could not detect any light below 1,700 ft. Fish and other organisms observed, many of them carrying their own illumination, were as active as surface animals and fish up to six feet in length were seen. It would seem that the usual trawling methods allow the larger and more active forms to escape. The dives have taken place off Nonsuch Island, Bermuda. Jesse Douglas and Philip Franklin: A step-polygon of a denumerable infinity of sides which bounds no finite area. Jesse Douglas: Crescent-shaped minimal surfaces. G. A. Miller: Groups generated by two operators of order 3 whose commutator is of order 2. J. L. Walsh: Interpolation and an analogue of the Laurent development.

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* Continued from p. 789.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 29

University of London, at 5.30—(at University College, Gower Street, W.C.1).—Prof. W. K. Gregory: "The Evolution of Man from the Lower Vertebrates" (succeeding lectures on May 30 and June 1).*

Institute of Education, at 5.30.—S. Charléty: "L'Etudiant à Paris à travers les âges".*

Royal Geographical Society, at 8.30.—Major R. A. Bagnold (read by W. B. K. Shaw): "The South-West Libyan Desert".

Tuesday, May 30

Royal Society of Arts, at 4.30.—Dr. H. E. Hurst (Director-General, Physical Department, Ministry of Public Works, Egypt): "The Sudd Region".

London School of Hygiene and Tropical Medicine, at 5.—Dr. F. C. Shrubsall: "Mental Deficiency" (succeeding lecture on June 1).*

Royal Aeronautical Society, at 6.30—(in the Lecture Hall of the Royal Institution).—Col. F. P. Lahm: "Training of the Airplane Pilot" (Wilbur Wright Memorial Lecture).

Thursday, June 1

University of Oxford.—Prof. H. N. Russell: "The Composition of the Stars" (Halley Lecture).

Friday, June 2

London School of Hygiene and Tropical Medicine, at 2.—R. R. Hyde: "Industrial Welfare".*

Institution of Mechanical Engineers, May 30–June 2.—Summer Meeting at Edinburgh.

Royal Institute of Public Health, May 30–June 4.—Annual Congress at Eastbourne. The Right Hon. Viscount Leverhulme, president.

Official Publications Received

Great Britain and Ireland

Imperial Bureau of Plant Genetics: Herbage Plants. Bulletin No. 8: Recent Research on Forage Crop Cultivation, Fodder Conservation and Utilisation, at the Animal Breeding Institute of the University, Königsberg. By W. Kirsch. Pp. 14. 1*s*. Bulletin No. 9: Vernalization, or Lyssenko's Method for the Pre-treatment of Seed. By Dr. R. O. Whyte and Dr. P. S. Hudson. Pp. 27+2 plates. 2*s*. 6*d*. (Aberystwyth.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1497 (T.3277): The Influence of Wing Density upon Wing Flutter. By A. G. Pugsley. Pp. 17+7 plates. 1*s*. net. No. 1499 (T.3288): Reversal of Aileron Control due to Wing Twist. By Dr. W. J. Duncan and G. A. McMillan. Pp. 22. 1*s*. net. No. 1500 (T.3314): Resistance Derivatives of Flutter Theory, Part 1. By Dr. W. J. Duncan and A. R. Collar. Pp. 14. 9*d*. net. (London: H.M. Stationery Office.)

Leeds University: Department of Pathology and Bacteriology. Annual Report by Prof. Matthew J. Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research by Prof. R. D. Passey. Pp. 15. (Leeds.)

Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), Nos. 20–26: Effect of the Conditions of Storage on the Vitamin D Potency and on other Features of Codliver Oil, by E. J. Sheehy; A Suggested Mode of Radiotherapy when Long-continued Feeble Gamma Radiation may be Desirable, by Dr. J. Joly; On the Colloidal Calcium Phosphate of Milk, by G. T. Pyne and J. J. Ryan; An Investigation of the Behaviour of Neon Discharge Tubes in a Flashing Capacity Circuit by means of a Cathode Ray Oscillograph, by Dr. J. H. J. Poole; Bast-Sap, by Prof. Henry H. Dixon; A Study of *Phoma lingam* (Tode) Desm., and the "Dry Rot" it Causes, particularly in Swede Turnips, by William Hughes; A Classification of the Biological Elements, with a Note on the Biochemistry of Beryllium, by Dr. William Robert Fearon; Experiments on the Suitability of some Rectifier Photo Cells for the Measurement of Daylight, by Dr. H. H. Poole and Dr. W. R. G. Atkins. Pp. 463–546+plates 44–47. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 7*s*.

Other Countries

United States National Museum. Bulletin 100: Contributions to the Biology of the Philippine Archipelago and adjacent Regions—The Land Shells of the Genus Obba from Mindoro Province, Philippine Islands. By Paul Bartsch. Pp. 343–371+plates 87–93. (Washington, D.C.: Government Printing Office.) 10 cents.

University of Denver: Department of Anthropology. Archæological Survey of Eastern Colorado, Third Report, Season 1932. By E. B. Renaud. Pp. 46. (Denver, Colo.)

Field Museum of Natural History. Report Series, Vol. 9, No. 2: Annual Report of the Director to the Board of Trustees for the Year 1932. (Publication 318.) Pp. 289–429+plates 23–31. (Chicago.) 1 dollar.

U.S. Department of the Interior: Office of Education. Pamphlet No. 34: School Administrative Units, with Special Reference to the Country Unit. By Walter S. Deffenbaugh and Timon Covert. Pp. 25. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the United States National Museum. Vol. 82, Art. 15: Description of Two Parasitic Nematodes from the Texas Peccary. By Benjamin Schwartz and Joseph E. Alicata. (No. 2956.) Pp. 6. (Washington, D.C.: Government Printing Office.)

Journal of Science of the Hiroshima University. Series B, Div. 2 (Botany), Vol. 1, Articles 10–14. Pp. 135–205+plates 17–25. (Tokyo: Maruzen Co., Ltd.) 1.42 yen.

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Mean Values of Observations from Danish Light-Vessels. Pp. 12. (København: G. E. C. Gad.)

U.S. Department of the Interior: Office of Education. Bulletin 1933, No. 3: A Symposium on the New Homemaking Education. Pp. ix+56. (Washington, D.C.: Government Printing Office.) 10 cents.

Bulletin of Yale University. Supplement: Report of the Director of Peabody Museum for the Academic Year 1931–1932. Pp. 32. (New Haven, Conn.)

Bulletin of the Geological Society of America, Vol. 43. Memorial of James Williams Gidley. By Richard Swann Lull. Pp. 57–68. (New York City.)

Proceedings of the American Academy of Arts and Sciences. Vol. 68, No. 5: Contributions from the Gray Herbarium of Harvard University, No. 102: 1. Studies in the *Bromeliaceæ*, IV, by Lyman B. Smith; 2: The *Bromeliaceæ* of Trinidad and Tobago, by W. E. Broadway and L. B. Smith. Pp. 145–188+2 plates. (Boston, Mass.) 90 cents.

Proceedings of the California Academy of Sciences, Fourth Series, Vol. 21, No. 7: The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 7: Dolichopodidæ and Phoridæ. By Millard C. Van Duzee. Pp. 65–74+plate 4. (San Francisco.)

Japanese Journal of Geology and Geography. Transactions and Abstracts, Vol. 10, Nos. 3 and 4, March. Pp. ii+83–182+13–20+plates 6–16. (Tokyo: National Research Council of Japan.)

Proceedings of the Physico-Mathematical Society of Japan. Third Series, Vol. 15, No. 2, February. Pp. 59–97. (Tokyo: Maruzen Co., Ltd.) 0.70 yen.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 10, No. 4, April, Research Papers Nos. 540–548. Pp. 427–578. (Washington, D.C.: Government Printing Office.) 25 cents.

Bulletin of the Academy of Sciences of the United Provinces of Agra and Oudh. Vol. 2, No. 3, February. Pp. 107–201. (Allahabad.)

Journal of the Chinese Chemical Society. Vol. 1, No. 1, April. Pp. 86. (Peiping: National University of Peking.)

Comité National Français d'Astronomie. Congrès National d'Astronomie des 21, 22, 23 juillet 1932. Pp. x+203. (Paris: Académie des Sciences.)

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History in Science

SPEAKING at Oxford a few days ago in connexion with the celebration of the 250th anniversary of the Old Ashmolean, Sir Frederick Gowland Hopkins, president of the Royal Society, made a strong plea for increased attention to the history of science in secondary schools and universities in Great Britain. He suggested that

> "the history of science—the history of the gradual development of the fundamental ideas and conceptions, perhaps its effect upon civilisation—might form the subject of school teaching and take the place of the purely technical teaching of science which the schools at present give. That would turn out not only men who are going to take up science as a career, but the right sort of teaching would give that sympathy with and understanding of science which we would fain have in our public men and in our citizens generally."

Two main ideas seem to be expressed in Sir Frederick Hopkins' words—one that the usual science teaching in schools is too specialised for the educational equipment of the rank and file: the other, that historical aspects of scientific achievement and progress afford a suitable means of creating interest in them without technical details. Both propositions have been given much consideration in recent years, and the results are to be found in various reports as well as in modern textbooks, a number of which are now available providing courses of general or everyday science, while others, dealing with specific branches of science, devote much more attention to the historical side than was formerly done.

These developments are all to the good and represent a reaction against the type of school science which seemed to assume that every pupil was to become a chemist, physicist or engineer. For the rank and file of pupils in secondary schools, who will not in most cases proceed to scientific careers, something more is needed than laboratory training in scientific method, and it can be found in descriptive lessons and reading on everyday applications of scientific discovery, such as are exemplified in industrial history, on the establishment of great principles, and on many interesting aspects presented by the broad field of natural fact and phenomena.

On account of pressure of school examination requirements, there are practical difficulties in making the science course extensive as well as intensive, but a way to overcome them is indicated in a report on "The School Certificate Examination" which was the subject of an article in these columns of February 18 last. The recommendation made in this report was that every candidate who presents himself in science in the School Certificate examination should take an obligatory paper covering an extensive field, of a general scientific knowledge character, and should take, in addition, special papers on physics or chemistry or biology, but if these three papers are taken then the candidate can be excused the general science paper. It is greatly to be hoped that the university authorities responsible for the conduct of School Certificate examinations will give serious consideration to this scheme and will introduce syllabuses which will encourage its adoption in schools.

In a general science course of the kind contemplated, the history of science would, however, only be incidental. The main aim would be to encourage intelligent interest in the objects and manifestations of Nature and the endeavours of men of science to understand and use them. The place of history in the development of a particular branch of science is another matter. Precise knowledge of the subject itself is required to understand the significance of the steps by which particular discoveries have been reached, and such details are inappropriate to a general science course.

Fifteen years ago, when Sir. J. J. Thomson was president of the Royal Society, he presided over a Government committee which produced a valuable report on "The Position of Natural Science in the Educational System of Great Britain". Among the chief recommendations of that committee was one on the importance of increased attention to the history of science. It was suggested that such courses are particularly suitable for students not specialising in science, and that they should deal, not only with the history of specific branches of science of general interest, but also with the development of scientific ideas, the lives and work of scientific men, the bearing of scientific inventions on industrial progress, and the method and philosophy of science historically treated. Among the subjects which come appropriately under one or other of these heads are historical considerations of the development of views on the constitution of matter; the conservation of energy; the doctrine of evolution; methods of transport by land, water, and air; means of communication, such as telegraphy, telephones, broadcasting; methods of lighting; and the schools of thought represented by Aristotle, Archimedes, Galileo and Newton, as well as the work of Pasteur, Lister, Faraday, Darwin and Mendel and other experimental philosophers. Courses of this kind give special opportunities to teachers who combine some knowledge of history with a knowledge of science, and they appeal to students with historical tastes.

Many science teachers to-day realise the value of courses in which the humanising aspects of history and biography are combined with the practical study by which the meaning of experimental method is appreciated. It is, however, one thing to point out the stepping stones which have been the path of scientific progress in a particular subject and another to show the bearing of discoveries upon the advance of civilisation. To the student of chemistry the relative contributions of Priestley and Lavoisier to the discovery of oxygen and its bearing on the phlogiston theory are of interest and importance, but in human history the discovery itself is not so significant as the use of oxygen in medicine, aviation and the arts.

The history of science may, indeed, be approached from two points of view. It may be regarded purely as growth of knowledge of natural objects and phenomena along the corridors of time, or it may be viewed selectively according to its influence upon social and economic conditions. Hitherto these two provinces have been surveyed by different groups of students, and only occasionally have the qualities required for the effective description of both been possessed by a single worker. The result is that we have on one hand histories of astronomy, chemistry, biology, and other branches of natural science, none of which discusses the relation of the knowledge to social conditions or effects, and on the other hand histories of countries and periods giving scant attention to scientific genius and its influence upon human life and institutions.

What is wanted is a closer co-ordination of these separate points of view in works on general history. No one now supposes that a descriptive catalogue of kings and the intrigues of their courts and governments constitutes the history of a country. The determining factors in social development may be rulers or governments or peoples or scientific knowledge; and the power exerted by these respective influences decides the extent and character of the national or international changes effected. Just as, in mechanical science, work is not considered to be done until the point of application of the force is moved, so history is being made only when the power used produces an effect. Regarded in this way, science in the history of civilisation becomes a study of scientific causes and human consequences, and not a continuous chronological record of the growth of natural knowledge.

For the education of most young citizens, therefore, whom Sir Frederick Hopkins appears to have in mind, we suggest that what is wanted is not the history of science as such but of its social and industrial influences. "No one," said Comte, "can be really master of any science unless he studies its special history, which again is bound up, at every step, with the general history of humanity." We have often been reminded in recent years of these social and economic contacts; and it is upon them that the chief emphasis should be placed when attention to the history of science is being advocated for students in schools or universities.

Preservation of Wild Life in India

AN appeal made by the Association for the Preservation of Game in the United Provinces of India, in the first report of the Association recently issued (Agra: Hasan Manzil, Shahganj) shows the need for concentrated and swift action in its support. For long years this area of India has suffered heavily; in part from the toll of life taken by sportsmen, and in part by the natives under one pretext or another. It is not only the existence of the larger mammals which is threatened, but also of bird-life, especially of the ducks, which have been, and are being, destroyed by thousands either by shooting or by netting.

The existing close-season regulations are more honoured, we are told, in the breach than in the observance, while the issue of licences to all and sundry is reckless; and these include not merely ordinary firearms but quick-firing and magazine rifles. A plea is urged for a revision of the present system of licensing and an embargo on shooting from motor-cars, over water-holes and salt-licks, and between the hours of sunset and sunrise. It is proposed to reduce the abuses which now exist in licences for the protection of crops. Here, as in Africa and elsewhere, this need for 'protection' has again been advanced for commercial ends.

Having regard to the innumerable devices which exist in the United Provinces for the slaughter of game, there is no occasion for surprise at the note of alarm which has been sounded. In some areas which were once prolific, game has been absolutely wiped out. All good sportsmen, we feel sure, will deplore the state of affairs which now exists, and will join hands with those who are anxious to beat out the fires of destruction before they spread further, for there is still a remnant of a glorious heritage to be saved.

More than this; the members of this Association realise that they are the trustees for posterity. The present generation has no right to slay until the slaying stops for lack of victims. It is their duty to see that this does not happen; and this not so much in order that generations yet unborn may have something left to shoot, but that those who come after us may be able to make amends for our own abuse of the opportunities presented for the right use of this game.

Hitherto, game has been simply exploited, either to serve the ends of 'sport', or of commerce. Of the haunts and habits of these creatures, all that has come to light only suffices to guide those bent on killing to their prey. The tiger knows as much. What is needed is a concentrated study of the various types of game as they live their daily lives, unsuspecting the presence of man. Here we shall find the key to the problems presented by their evolution—what governs their choice of food, and its abundance, what governs their coloration, and their 'behaviour' in varying circumstances, their adjustments to their environment, and a hundred other similar problems.

These aspects in the life-history of game-animals never entered the heads of the older sportsmen: they are beyond the ken of the native *shikaree*. But they will be of vital importance to those who come after us; and we have no right to deprive them of their birthright, merely to satisfy the thirst for securing records, and 'trophies'.

The United Provinces, and the world at large, owe a debt which cannot easily be repaid, to His Excellency the Governor, Sir William Malcolm Hailey, the patron of the Association, and to its founders, the joint honorary secretaries, Major J. Corbett and Mr. Hasan Abid Jafry, who are sparing no efforts not merely to secure the necessary legislation, but also, what is quite as important, to spread a knowledge of the wild-life of India among the rising generation, by propaganda work. The Association seems at present to be the only one of its kind in India, but as conditions in the United Provinces apply also to many other parts of the country, it may be hoped that similar organisations for the preservation of game will be established.

Evolution Up to Date

The Mechanism of Creative Evolution. By Dr. C. C. Hurst. Pp. xi+365. (Cambridge: At the University Press, 1932.) 21*s.* net.

BY reasoning and reasonable men, evolution is now generally accepted as an article of faith. For though it cannot be proved in the sense of a mathematical proposition, the circumstantial evidence in its favour is overwhelmingly strong. When, however, we come to inquire into the manner in which it has come about, we are at once beset with difficulties. In the earlier days of evolution, and to some extent even to-day, these difficulties resulted merely in differences of opinion. For the doctors attempted to meet them by "argument about it and about", and the seeker after knowledge "evermore came out by that same door wherein he went". To-day this is all changed: or should be. Evolution may still be an article of faith, but heredity and variation, the so-called 'principles' on which it rests, have long since become matters of definite experimental inquiry.

In the last edition of "The Origin", Darwin stated that "the laws governing inheritance are for the most part unknown", and at the same time freely confessed to "our ignorance of the cause of each particular variation". With the rise of genetics, heredity has become an exact science, even as chemistry or physics, and the worker can plan out his experiments, knowing that in the fullness of time he will obtain a definite answer to a definite problem. The study of variation, too, has made immense progress in the past few years. Definite variations have, in many cases, been tracked down to definite alterations in the chromosomal content of the cell, sometimes alterations of addition, sometimes of subtraction. Moreover, the geneticist, no longer content merely to analyse what Nature offers, is producing variation by artificial means. Just as bombardment by X- and other rays is used by the physicist to analyse the constitution of the atom, so in a milder manner is such bombardment now being used by the geneticist to analyse the constitution of the chromosome and of the gene.

All this fresh influx of knowledge concerning the processes of heredity and variation must of necessity affect profoundly our conception of the manner in which evolution has come about. New and stimulating facts have been flowing in so rapidly that no worker yet appears to have had either the leisure or the inclination to set them out in a manner which can be readily comprehended by the general reader.

This gap Dr. Hurst has essayed to fill in the volume before us. It is a volume that should make an instant appeal to all who wish to know what is going on in one of the most rapidly progressing and exciting lines of present-day biological research. It is written with a lucidity that should render it easy reading even to those whose knowledge of this branch of science is relatively small. The author has reduced his use of technical terms to a minimum, and even where they cannot be avoided, their use should present no difficulty to the uninstructed reader of ordinary intelligence.

The aim of the book is to explain how the problems of evolution appear through the new genetical spectacles. It starts with a brief account of the nature of Mendel's discovery, and of the manner in which the facts of the geneticist fit in with those of the cytologist, showing that our conception of the constitution of the living creature is largely to be expressed in terms of the chromosomes and their contained genes, which are included in its living cells.

The bearing of all this on the nature of species is more clearly realised when the author comes to a discussion of hybridisation and polyploidy, a subject on which he is an admitted expert. Experimental mutation provides an attractive chapter, as also do the somewhat speculative ones on the nature of the gene and its relations to the smallest living organisms such as the viruses and the bacteriophages.

Taking it altogether, Dr. Hurst may be congratulated on an adequate and clear, semi-popular account of a subject advancing so rapidly that to treat of it in this manner is a matter of no little difficulty. If the book obtains its deserts, a new edition should be called for at no distant date, and for that reason we may direct attention to a few minor defects. Some of the figures, for example, Figs. 42 and 47, could well do with a little more explanation. The phenomenon of 'translocation' (p. 68) would be rendered clearer if illustrated with a good diagram. 'Deficiency', though illustrated by a diagram (Fig. 52), would be clearer for a rather fuller account in the text. Though Harrison's account of the appearance of melanic *Selenia* on treatment with certain chemicals is referred to and illustrated, no mention is made of McKenny Hughes's more recent failure to confirm that account. There are a few obvious misprints, for example, *Rhœa* for *Rhœo* (p. 78 and index), *Solensbia* for *Solenobia* (p. 259), *cerviciœ* for *cerevisiœ* (p. 274), *Collozoun* for *Collozoum* (p. 301). These, however, are minor blemishes in a book that is admirably printed and sumptuously illustrated. Though it may be rather on the expensive side, the purchaser can be assured that he will be obtaining a really beautifully produced book for his money.

Talking Pictures and Picture Telegraphy

(1) *Handbuch der Bildtelegraphie und des Fernsehens: Grundlagen, Entwicklungsziele und Grenzen der elektrischen Bildfernübertragung.* Bearbeitet und herausgegeben von Prof. Dr. Fritz Schröter. Pp. xvi + 487. (Berlin: Julius Springer, 1932.) 58 gold marks.

(2) *Tonfilm: Aufnahme und Wiedergabe nach dem Klangfilm-Verfahren.* (System Klangfilm-Tobis.) Herausgegeben für die Klangfilm G.m.b.H., Berlin, von Dr. F. Fischer und Dr. H. Lichte. Pp. xi + 455. (Leipzig: S. Hirzel, 1931.) 27 gold marks.

(3) *Einführung in die Tonphotographie: photographische Grundlagen der Lichtton-Aufzeichnung.* Von Prof. Dr. John Eggert und Dr. Richard Schmidt. Pp. vi + 137. (Leipzig: S. Hirzel, 1932.) 7 gold marks.

(1) PROF. SCHRÖTER and the authoritative collaborators whom he has gathered round him for this important book have done a great service to the study of the scientific and technical foundations of picture telegraphy and television. This is no mere compilation from the scattered literature of these two aspects of a single problem; it is a well-knit collection of original discussions, by recognised experts of wide experience, of the fundamental physics of the subject and of the practical engineering progress achieved. It clears television of much of the empiricism and wrong thinking which has characterised the somewhat unhappy history of that most attractive of subjects; it might have been modelled on the best interpretation of the startling but, within the implied limits, perfectly fair sentence which Prof. Karolus uses in his introductory note to the book, "Es gibt nichts Wunderbares".

The eleven chapters of the book deal in turn with: the methods of image dissection in phototelegraphy; the methods of image dissection in television (telecinematography); laws, problems, and limitations of scanning; photoelectric cells; picture recording and light modulation; synchronisation of picture telegraph apparatus; the picture amplifier; wireless picture transmission; wireless picture reception; picture transmission by line; and the forms and applications of the apparatus. There is a short but useful appendix of photometric and optical data, a specially convenient name index, and an adequate subject index. In a work in which all is well done, it is perhaps invidious to select items for special mention, but Prof. Schröter's own chapters on scanning or image dissection (chaps. i and iii), seem specially valuable because of their philosophical balance.

The specimens of transmitted pictures might lead a cynical critic to ask why those mountains of scientific knowledge and technical ingenuity are made to bring forth these mice, but such an inquiry would lead beyond the bounds of technology, possibly into entanglements with technocracy, without the promise of intellectual or æsthetic satisfaction in the end. One is convinced that the picture-telegraph engineer is much less interested in the fashion-plate or finger-print he sends across continent and ocean than in the joy of sending; that the æsthetic pleasure is in the process and not in the picture.

The book is produced in the best traditions of German scientific publishing, and its somewhat high cost in sterling is fully justified by its intrinsic merit.

(2) This description of the Klangfilm-Tobis system of sound-film working, edited by members of the staffs of the Siemens-Halske concern and of the Allgemeine Elektrizitäts Gesellschaft, has much in common with the book noticed above. Both books deal essentially with alternating current technique over a wide frequency range, and both find common ground in electro-optics. Within its narrower limits of subject matter, this book has the same width of scientific outlook, the same determined attack on fundamentals before technical tricks are discussed, and the same success in bringing together practically all the material required for a full understanding of the system. Drs. Fischer and Lichte have fulfilled their aspiration towards "a comprehensive scientific work in which all questions of the modern sound-film development are treated".

The first 250 pages of the book are devoted to the physical principles of the Klangfilm system. This section opens with short discussions on the Kerr cell, the oscillograph, the optical systems for the variable density and the variable area methods, the selenium cell, the photo-cell, the wax-disc recorder and the pick-up. Then follow chapters on the photographic principles of the variable density method, on microphones and loud speakers, amplification with special reference to tone correction, linear and non-linear distortion conditioned by the photographic process and by the apparatus, and the audibility of non-linear distortions. Adequate references by footnote and by bibliography are attached to the individual chapters.

The second half of the book contains a very full and very fully illustrated description of the individual parts of the complete Klangfilm apparatus, and ends with a short chapter on architectural acoustics and a description of the Neu-Babelsberg sound-film studios of the Ufa concern.

The copiousness of the pictorial aids to exposition is shown by the fact that the 450 pages of the text contain 378 illustrations.

(3) Prof. Eggert and Dr. Schmidt, writing from the scientific central laboratory of the photographic section of the I.G. concern, "Agfa", write in the tradition of the two works already noticed; their acknowledgments to Dr. Lichte underline the complementary relationship between this work and that of Fischer and Lichte. The book is devoted to a careful study of the part which the photographic processes play in the ultimate fidelity of reproduction from the sound-film. In the first fifty pages the authors summarise briefly but adequately the acoustic and mechanical foundations of sound-film technique; in the next fifty pages they deal with the photographic principles and processes.

The authors discuss the important differences among the characteristics of photographic response to weak illumination for several seconds, as in sensitometry, to moderate illumination for substantial fractions of a second, as in ordinary 'instantaneous' and cinematograph exposures, and to strong illumination with exposures of the order of 30 microseconds only as in sound-film photography, and show that the relative response as between the first and third cases is independent of the time of development, in a given developer. The resulting 'ultra-short-time' factor and the factor relating response to the diffuse light of sensitometry with the different response to the nearly parallel light of the sound-film processes are important in the practical control of these processes. The next section of the book deals with the frequency response characteristics of film materials, while the last section discusses the special properties of the range of "Agfa" films available for sound-film work.

The book ends with a list of references in which it is significant that the specific references to German, American and British sources are as 32 to 15 to 1, while the general list of journals dealing with sound-film questions contains three German, three American, one French and no British publications.

All three books are to be recommended to those interested in the remarkable development of the new arts based on electro-optics and electro-acoustics, and also to any who require reassurance as to the sure scientific foundations on which these typical modern industries are built, and as to the scrupulously quantitative technical knowledge which is embodied in every detail of their working.

Scott's Own Expedition

A Very Gallant Gentleman. By L. C. Bernacchi. Pp. 240+8 plates. (London: Thornton Butterworth, Ltd., 1933.) 8*s.* 6*d.* net.

COMMDR. BERNACCHI is a suitable writer for the first biography of Capt. Oates because he himself sledged over the Ross Barrier in Antarctica where the Scott tragedy occurred. He was physicist on the first expedition that wintered in the southern continent; he was also physicist in the *Discovery*, and he has introduced a little natural science into the biography. The science is well 'sugar-coated', for the book is popular though well-written. It also raises the question of publicity, commonly confused with merit, in connexion with recent expeditions; some of the best work has been done by explorers who are averse to the limelight.

Two subjects are treated in the book: the short life of Oates, and Scott's last expedition; they were closely connected, but the expedition occupies more space than the biography, which is the ninth volume inspired by this expedition, in addition to other writings and a wonderful film. Such profuse publicity is not objectionable unless it misleads those who do not know the work of other explorers.

"A Very Gallant Gentleman" is one of the best of the nine volumes for the ordinary reader, because most of its predecessors were larger and because Commdr. Bernacchi is a powerful writer.

The scenes, as he depicts them, live before the reader as vividly as in a film, even though there is little that is new; and the story was worth telling for the seventh time. The style is virile, and the pages of the book are adorned with some fine phrases and passages. Aesthetes may find the colour-tones strong, though others should not complain. There are, however, pages of irrelevant, if interesting, matter such as the description of Byrd's expedition; and there are a few inaccuracies. The *Discovery* expedition was not Capt. Scott's; he was appointed to its command. Sixty-five miles is by no means a three days' journey with dogs; Rasmussen drove ninety-four miles in one day, and 41 miles with 185 dogs on another day. In 1912 he drove four sledges, with 53 dogs, 296 miles in six days to end a journey of 630 miles in 26 days. Dog transport should not be classed with fancy sledging as if the necessity for cutting down weights to the last ounce existed. The average height of the Barrier usually accepted is 150 feet, not 200 feet above sea level.

There is also some repetition; but the book is well able to bear these small defects, and it shows that Oates was a fine character, worthy of a biography. He was lame from a wound received in South Africa where, incidentally, he was not the only officer to earn the title 'No surrender'. This book should be read by every boy as an inspiration to high endeavour, and it is hoped that the day will never come when such heroism as it depicts will be forgotten. Most of the illustrations are Mr. Ponting's.

J. G. H.

Growth of Space Chemistry

Stereochemie. Von Prof. Stefan Goldschmidt. (Hand- und Jahrbuch der chemischen Physik, herausgegeben von A. Eucken und K. L. Wolf, Band 4.) Pp. xiii+311. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1933.) 29 gold marks.

FOR a long period Alfred Werner's classical "Lehrbuch der Stereochemie" (1904) held undisputed sway as the standard work on this branch of science. With the passage of time, and more particularly during the last few years, the need has become manifest for a fresh and up-to-date treatment of a rapidly expanding field of science which now claims the interested attention of chemist and physicist alike. Accordingly, several books dealing with the subject of spatial chemistry have appeared lately in rapid succession. None of them can be held to be entirely satisfying.

A glance at the list of contents of Prof. Goldschmidt's volume conveys the impression that he has fully covered his extensive field. There are sections on the stereochemistry of carbon, nitrogen and other elements; optical rotatory power and chemical constitution; and spatial configuration and reaction-velocity; while Dr. R. Bloch contributes a concluding section on the relationships existing between stereochemistry and crystallography. It may be said at once that the major part of the book can be read with pleasure and profit, and that it constitutes a useful contribution to the literature of stereochemistry.

After undertaking a detailed examination, however, one is left with the impression that the book falls between the two stools of a students' textbook and a work of reference. Moreover, although some of the sections do not call for serious criticism, others are unbalanced and show signs of hurried and uncritical compilation: here, much unnecessary information has been included, and there, the account is flimsy. In general, also, scant justice has been done to the work of British stereochemists.

The weakest part of the book is the treatment of methods of optical resolution—a subject of primary importance in a treatise on stereochemistry. The description of the method of spontaneous separation contains no mention of Purdie's fundamental work on inoculation—in fact, Purdie's name does not appear in the book. The particularly interesting example of the *iso*hydrobenzoins also passes unnoticed: but for this, the author would probably have modified his earlier statement (p. 18) that "experimentell nicht sicher geklärt ist die Frage, ob die Spiegelbildlichkeit der Moleküle auch *stets* in der Asymmetrie der Kristalle zum Ausdruck kommt" (compare *J. Chem. Soc.*, 2307; 1929). Here, as is so often the case in recent publications on stereochemistry, the author reproduces an opinion or statement from an earlier work without revising it in the light of later research. McKenzie's activation of racemic acid with *l*-malic acid has no bearing upon the work with which the author associates it in this section.

The description of Pasteur's second method of optical resolution and its extensions is similarly lacking in essentials. Some of the optically active camphor acids are mentioned, it is true; but there is no direct indication of the enormously important part these fundamental stereochemical reagents have played in the development of this branch of science. Incidentally, the formation of partial racemates in this type of resolving process is much commoner than the author supposes; and he does not mention other difficulties, such as the frequent formation of solid solutions, and the great tendency towards racemisation when the asymmetric molecule contains fewer than three carbon atoms. The method of resolving *dl*-alcohols by direct esterification—probably the most effective of all—is not noticed.

Hydroxymethylenecamphor, a stereochemical reagent of outstanding interest and value, is not referred to in the book. The ordinary use of this substance as a resolving agent is well known; but perhaps the most striking example of an optical resolution achieved by the so-called dynamic modification of Pasteur's second method is that of *dl*-*ac*.-tetrahydroquinaldine with *l*-hydroxymethylenecamphor (1913). The reaction is almost instantaneous; the two diastereoisomeric products are formed in the approximate proportion of 3 : 2; and the excess of one of them is easily removed. This remarkable optical resolution has found no mention in any textbook of stereochemistry known to the reviewer.

The note—for it is little more—on the biochemical method of optical resolution is quite inadequate. Indeed, the biochemical aspects of stereochemistry receive surprisingly little attention in any section of the book, and this strange neglect extends even to the brilliant series of investigations conducted in this field during recent years by Neuberg. The statement that *Penicillium glaucum* destroys only the *d*-component of ammonium racemate is another example of failure to correct an earlier and inaccurate opinion.

In the account of spirane derivatives (p. 40) the omission of Pope and Whitworth's *spiro*-5, 5-dihydantoin (1930) is regrettable, as this substance is the most interesting optically active compound of the class. Reference should have been made also to diamino-*spiro*-*cyclo*heptane (1932), the optical resolution of which is more impressive than that of the related *spiro*-*cyclo*heptanedicarboxylic acid. A somewhat similar remark applies to the omission of the diphenylethylene oxides (1930) in a discussion of the diagnosis of *trans*-forms by optical resolution (p. 118). In a different field, some attention should have been devoted to the numerous interesting publications by McKenzie and his co-workers in the last few years on the retention of optical activity during the migration of groups in de-amination and dehydration processes directly affecting the sole final asymmetric carbon atom in the system. The name of Tiffeneau does not occur in the narrative at all; and there is no reference to the optically active benzoins, with their important bearing upon the preparation of glycols and upon racemisation. The treatment of racemisation, asymmetric synthesis, and the Walden inversion is inadequate and partly incorrect: for example, at least four inaccuracies occur in the allusions to asymmetric synthesis on page 29, and the reference on the following page to the work of Marckwald and McKenzie is unintelligible.

A failing which this book shares with other recent Continental publications on chemistry is the gross carelessness shown in quoting names of investigators. We meet in Prof. Goldschmidt's pages such metamorphosed colleagues as W. Markwald, M. Lowry, F. Armstrong, A. N. Champbell, W. Cloogh, M. St. Lesslie, S. Patterson, P. Jakobson, H. Pillips, M. Jaeger and W. S. Keutish; H. Pickard in the text reverts to R. H. Pickard in the footnote (p. 24); W. J. Pope and S. J. Peachey appear in their normal guise on p. 83, but reappear later in sundry disguises, such as J. Pope and St. J. Peachey and W. J. Pope and J. Peachy; sometimes only one author is quoted for a collaborative paper; O. Jones publishes in the "Pr. Cambridge Soc."; another investigator is made to disprove his own work after his decease (p. 167); and the present reviewer is resolved into a dual personality, both in text and index, owing apparently to his having undergone a Walden inversion, resulting in a change from the *R*- to the *L*-form!

Such mistakes, if sometimes trivial, are irritating and indefensible; moreover, they appear to pass from one book to another. Inaccuracies in such points are unworthy of a book of the kind under notice, and they are apt to undermine the confidence of the reader. As examples of more serious errors, the following may be noted: "β-phenylethylamine" appears for "α-phenylethylamine" throughout the book; mandelic acid is not converted by nitrous acid into phenylaminoacetic acid (p. 94); no such compound as that indicated at the foot of p. 24 was described by Pasteur; and the alkaloids originally used by Pasteur in the optical resolution of racemic acid (1853) were cinchonicine and quinicine, and not cinchonine, as stated (p. 23).

The book is excellently produced, and the numerous diagrams are neat and effective. The index could be improved. The price, which at the present rate of exchange is about £2, is high.

JOHN READ.

Short Reviews

(1) *Logarithmetica Britannica: being a Standard Table of Logarithms to Twenty Decimal Places.* By Dr. Alexander John Thompson. Part 5: *Numbers 50,000 to 60,000.* (Tracts for Computers, No. 17.) Issued by the Biometric Laboratory, University of London, to commemorate the Tercentenary of Henry Briggs' publication of the *Arithmetica Logarithmica*, 1624. Pp. iv + 100. (Cambridge: At the University Press, 1931.) 15*s.* net.

(2) *Primes and Factors.* Computed by Emma Gifford. Pp. vi + 94. (Manchester: Printed by Abel Heywood and Son, Ltd., 1931.)

(3) *The Nomogram: the Theory and Practical Construction of Computation Charts.* By H. J. Allcock and J. Reginald Jones. (The Specialists' Series.) Pp. viii + 209. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 10*s.* 6*d.* net.

(1) PART 5 (the fourth to be published) contains the logarithms of the integers from 50,000 to 60,000. The frontispiece is a photographic reproduction of the title page of Briggs' "Arithmetica Logarithmica" (1624).

(2) Every prime number which is greater than 10 is included in the form $N = 6x \pm 1$. This volume gives all values of N from $x = 2$ to $x = 16{,}731$ together with the factors, if any. The table therefore contains all primes between 11 and 100,379. The terminal digits of each group of eight consecutive numbers are 1, 3, 7, 9, 3, 9, 1, 7 in this order. Each column of the table contains 56 numbers. With this arrangement, all numbers N in the same horizontal line have the same terminal digit. It is thus easy to find and factorise any number which falls within the limits of the table. The pages are well arranged and clearly printed. The volume should prove very useful.

(3) Alignment charts and other forms of nomogram are now widely used for rapidly obtaining approximate values of a number which is given by means of a formula containing several variables. The present volume combines successfully a study of the theory with practical directions for the construction and use of computation charts. The theory is based upon the determinant, the evanescence of which expresses the condition of collinearity of three points. The method is easily apprehended and readily applied. L. M. M.-T.

My Life and Thought: an Autobiography. By Albert Schweitzer. Translated by C. T. Campion. Pp. 288 + 8 plates. (London: George Allen and Unwin, Ltd., 1933.) 10*s.* 6*d.* net.

THIS book makes large demands on the reader, who is left to discover for himself the real eminence of Schweitzer alike as preacher or theologian, as musician, as doctor and as philosopher. In spite of the wealth of material for a romantic and heroic biography, there is little of the wide appeal of Schweitzer's narratives of his work in Lambaréné—"On the Edge of the Primæval Forest" and "More from the Primæval Forest". Apart altogether from the interest which any such attempt to face the fundamental problems of civilisation, to relate ethical and moral with material progress and values must possess, a rare and unmistakable honesty pervades the book which should give it added interest to the scientific worker. Here is a man of fourfold eminence facing frankly some of the fundamental problems of this generation, and, in his exposition of philosophy, giving us the clue to the understanding of the preacher, the musician, the physician.

Schweitzer's consideration of the relations between civilisation and ethics and attempt to discover the causes of the world catastrophe in a false world view, or sense of values, is somewhat pessimistic and leads him to conclude that there is no natural order of life values which man can discover. He adopts in consequence the principle of reverence for life as the only guide, and attacks the spirit of the age for its disdain for thinking, for the discouragement given to the individual to arrive at his convictions by his own thinking. "Renunciation of thinking," he declares, "is a declaration of spiritual bankruptcy. Where there is no longer a conviction that men can get to know the truth by their own thinking, scepticism begins." He attributes the difficulties of the machine age to the absence of a world view capable of counteracting tendencies destructive of civilisation. A challenging note, an almost passionate effort for honesty and sincerity of thought, breaking through the pessimism of the thought, like the inspiration of the man's personality no less than of his achievements, relieves the sombreness of what is near to being a disappointing book. Schweitzer writes shrewdly on problems involved in the relations of the backward races of Africa and European civilisation and his sense of service and missionary outlook are never allowed to deflect his scientific observation or judgment. R. B.

(1) *Ergebnisse der kosmischen Physik.* Herausgegeben von V. Conrad und L. Weickmann. Band 1. (Gerlands Beiträge zur Geophysik, Supplementband 1.) Pp. xi + 448. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1931.) 46 gold marks.

(2) *Atmospheric Electricity.* By Dr. B. F. J. Schonland. (Methuen's Monographs on Physical Subjects.) Pp. vii + 100. (London: Methuen and Co., Ltd., 1932.) 2*s.* 6*d.* net.

(3) *Die Aufrechterhaltung der elektrischen Ladung der Erde.* Von Prof. Dr. Egon Schweidler. (Probleme der kosmischen Physik, herausgegeben von Prof. Dr. Christian Jensen und Prof. Dr. Arnold Schwassmann, Band 15.) Pp. iv + 68. (Hamburg: Henri Grand, 1932.) 5 gold marks.

(1) THE title of the first of these books is somewhat misleading, its subject being geophysics, and having

only incidental connexions with extra-terrestrial phenomena. The book is a contribution of exceptional value to the compilation-literature of science. It opens with an admirably comprehensive and concise account (86 pages) of auroræ, by C. Størmer, which is beautifully illustrated. Then follow two articles on special aspects of the penetrating radiation, namely, the barometer effect and the absorption coefficient, by W. Kolhörster and L. Tuwim; an account of atmospheric ozone, by P. Götz, and of abnormal sound-propagation in the atmosphere, by P. Duckert; and articles on geodesy, by F. Hopfner, and upon waves in air, water, and on sand, by F. M. Exner. The book is well bound and well printed, but its high price is regrettable.

(2) and (3) The present undue costliness of books published in Germany is emphasised by the other two books here noticed; they deal with substantially the same subject, and with about equal authority. The English book, unlike the German one, is bound, and is printed on equally good paper; it is in slightly smaller type, but contains about 25 per cent more words than the other; its price, even apart from the depreciation of sterling, is about half that of the German book.

Schonland's book gives an admirable short review of the electrical phenomena of the lower atmosphere, up to 10–15 km., and includes a chapter on the penetrating radiation. Schweidler limits his account to one special (but central) problem of atmospheric electricity, the maintenance of the earth's charge; he is more diffuse than Schonland, and while the latter does not cover every topic discussed by Schweidler, his book is undoubtedly the better introduction to the subject.

Blackboard Coloured Diagrams: Biological Series. Rana temporaria (The Common Frog). 44 in. × 31 in. *Rana temporaria* (Skeleton). 44 in. × 31 in. *Rana temporaria* (Brain and Nervous System). 44 in. × 31 in. (London: Sidgwick and Jackson, Ltd., 1933.) Mounted on cloth, eyeletted, 10*s*. 6*d*. each.

THESE diagrams are printed upon a black background as if drawn upon a blackboard and the actual area covered by the illustrations is 40 in. × 29 in. on each sheet. No names or key letters are provided and this is in some ways an advantage since it allows the instructor to give as many or as few technical names as may be thought desirable and enables them to be used for questioning. From their size they are adapted for use with small classes, say up to 50 but not to large lecture theatres accommodating 200–300 students. Even then, some of the smaller drawings, as, for example, the end-on view of the atlas vertebra and the diagram of the relationship of the dorsal and ventral nerve roots to the skin and a piece of muscle, are so small that they could only be seen properly in the front rows and would need to be examined at closer range by the students.

The diagrams are not all of the same standard. That of the skeleton is the best and reaches a high standard. The general illustration of the viscera is not quite so good nor is that of the nervous system, even allowing for the fact that they are not such satisfactory subjects for treating in this manner as a skeleton. In the former, some of the viscera are rather 'wooden' in appearance, for example, the fat bodies, and in the latter the general drawing of the nervous system is much like that of Ecker, which is very diagrammatic and exhibits an arrangement of the sympathetic nerves unlike that seen in ordinary dissection. Apart from these relatively minor points, the diagrams are well drawn and executed and should prove useful in schools and institutions where the classes are not large.

Reports of the Progress of Applied Chemistry. Vol. 17, 1932. Pp. 728. (London: Society of Chemical Industry, 1933.) 12*s*. 6*d*.; to Members, 7*s*. 6*d*.

THE volume of reports on the progress of applied chemistry during 1932 has appeared with customary promptitude and again reaches a high standard. This annual publication is one which few progressive chemists neglect to study. Many regard it as among the most useful books in their own libraries, and none can afford to ignore it. Moreover, dealing as it does with the general outline of progress in the various chemical industries and of industries in which chemistry enters as an aid to control and development, as well as describing very many of the more important technicalities underlying present and future progress, it appeals to the interest of the non-technical man who desires to keep *au fait* with the march of events in extremely important branches of the world's work.

The reports are presented in familiar form, are fully annotated with references to original papers and summaries to be found in "British Chemical Abstracts", and are provided with name and subject indexes. The report on explosives covers the years 1931 and 1932, and that which formerly dealt with fibres, textiles, cellulose and paper has been expanded into two separate reports. A. A. E.

Wanderers Wetterbuch: Einführung in das Verständnis der Wettervorgänge. Von Dr. Otto Myrbach. Pp. vi + 184. (Leipzig: Verlag Berg und Buch, n.d.) n.p.

To anyone with a love of Nature and a moderate knowledge of German, this book should make a definite appeal. The reader is introduced step by step to the elements of weather, the movements of air masses, clouds, rain and fine weather. Official forecasts and their application to local conditions are explained and this chapter is supplemented by one on local weather signs, but the largest and most interesting part of the book deals with weather in the mountains, ending with a four-act drama of a storm on the Zugspitze.

Forest Fires in Relation to Soil Fertility

By PROF. F. P. WORLEY, Auckland University College, New Zealand

WHEN the early colonists arrived in New Zealand, the greater part of the present cultivated land of the North Island and much of that of the South Island were covered with dense forests, which have since been removed by burning, the general practice being to remove millable timber, fell the remainder, burn out as completely as possible and sow with grass. Much of the forest was, however, burned without felling, sometimes by accident but often intentionally.

Although large areas of native forest still remain, the bush in the South Island is largely confined to mountainous regions. In the North Island, although the greater part of the remaining bush is on mountain ranges, there is still a large area of bush land that will gradually be brought into cultivation. The method of forest removal is not far removed from the primitive methods employed by some African native tribes.

Although it may be conceded that burning is the only practicable method of bringing bush land into cultivation, far too little consideration appears to have been given to the influence of forests on soil fertility and to the possible damage to the soil by the methods of burning employed. It is very obvious in numerous cases that areas formerly covered by luxuriant bush frequently have surprisingly low fertility. It has only to be recalled that the poor 'gum lands' of the North Auckland peninsula were once covered by dense kauri forests full of rich undergrowth. In other parts of the country, hillsides formerly covered by good bush, such, for example, as the coastal districts north of Wellington, have a fertility sadly below that to be expected from the luxuriance of the former bush.

It is necessary to inquire whether this apparent deterioration of fertility may be due to the method of forest removal and, for this purpose, consideration must be given to certain aspects of the part played by the forest in bringing virgin rocky land into a condition of fertility. The process can be observed on the volcanic island of Rangitoto at Auckland, where a formerly barren island of rough basalt is in process of being converted by the bush into rich, fertile land. It is not known how many hundreds of years it has taken for the island to reach its present degree of fertility, or how long it will be before the rocks are covered with fertile soil, but the process of humus formation is plainly obvious. What is not obvious, however, is the process of bringing to the surface and making available for plant growth the mineral constituents of the rocks.

The only artificial fertilisers intentionally applied to the land for agricultural purposes, apart from lime, are those supplying potassium, phosphorus and nitrogen. It is now recognised, however, that most of the other common elements occur in plants, though generally only in minute amounts, and that some of these minor constituents are essential to plants and to animals. Some may be present only fortuitously, but it is impossible to deny that they may have specific functions. Manganese and copper, for example, have been found in all plants investigated and are associated with rapidly growing parts, such as buds and leaves, and probably have a functional importance.

The small amounts of such elements in the soil are extracted by the roots of trees and transported to the growing parts, being eventually shed in the falling leaves, thus enriching the surface soil. This enrichment of the surface soil at the expense of the deeper soil by trees was clearly shown in the case of manganese by Bishop[1], and further investigations of a similar nature are desirable. Maquenne and Demoussy[2] examined the distribution of copper in a number of cultivated trees and shrubs and found the copper concentrated in the actively growing parts. Analyses of various parts of the native karaka tree have shown that the copper is concentrated in the leaves and seeds of this tree, and the same will probably be found in the case of other native trees. Copper is present normally only in minute amounts in the soil, but is gradually brought to the surface, like manganese, by tree growth. It is obvious that forests, besides building up a surface layer of humus, exercise the very important function of bringing to the surface various chemical elements extracted from the deeper soil. This process is cumulative and may extend over many hundreds of years.

In view of these considerations, it is possible to appreciate the damage that may be done by forest fires. Not infrequently the burning is sufficiently thorough to burn away the humus. On hilly ground the ash may be almost entirely washed away by rain, with the result that the beneficial cumulative work of the forest carried on over vast periods may be destroyed in a day. Unless the ash and the humus can be retained, the work of the forest has been not only in vain, but even actually detrimental, in that the soil to the depth of the tree roots will have been impoverished in minor mineral constituents essential to healthy growth of plants and animals.

On flat land the floor of the forest is usually damp. Here there is less likelihood of complete destruction of humus by fire and of ashes being washed away either mechanically or in solution, except on very porous soil, but on hill and mountain-side the destructive effects of bush fires may be disastrous.

The comparative infertility of the gum lands north of Auckland is probably due very largely to the destruction of the forests and the surface soil of the hills by great fires. In the low-lying and swampy gum lands a layer of ashes, covered often by many feet of black peat, overlies the remains of a kauri forest. Frequently, at a lower level there is another layer of ashes above the roots of a still earlier kauri forest. The prehistoric fires that destroyed these forests doubtless destroyed the forests on the hilly ground, where kauri gum occurs very near the surface. The humus on the sloping ground was apparently destroyed and the ashes washed down into the sea. In recent years the scrub has been burnt off by gum diggers and others and further damage done to the fertility of the soil.

On very porous soil the mineral constituents of ash derived from forest fires may be washed down through the soil. Should there be a tendency towards any mineral deficiency in such soil, this deficiency may be greatly intensified by leaching. On soil of this nature it would appear desirable to grow deep-rooting crops to bring to the surface the small amounts of essential minerals, and to produce a retentive layer of humus. Much working, with consequent drainage and leaching of the surface soil, should be avoided.

It appears probable that humus may have mineral as well as biological importance and more analyses are desirable of its mineral content, particularly for those elements that occur only in minute amounts in underlying soil or rock. It is obvious that if the normal soil and rock is in any way deficient in minor mineral constituents essential to the full health of plants or animals, this deficiency will become serious if the humus in which such constituents have become concentrated is destroyed and the ashes removed.

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[1] *Australian J. Expt. Biol. Med. Sci.*, **5**, 125; 1928.

[2] *C. R. Acad. Sci.*, **170**, 87; 1920.

Canadian Water Power Development in 1932

By DR. BRYSSON CUNNINGHAM

THE strides by which Canada continues to advance in the exploitation of the water power resources of the Dominion for the generation of electricity are as remarkable as the abundance of the resources themselves. According to a report[1] recently issued by the Water Power and Hydrometric Bureau of the Department of the Interior, the total turbine installation at the end of 1932 amounted to more than seven millions (7,045,260) horse power, showing an increase of 378,923 horse power over the corresponding figure for the previous year. This gives an average of 670 horse power per 1,000 of population, a ratio which places Canada in an outstanding position among the water power-using countries of the world.

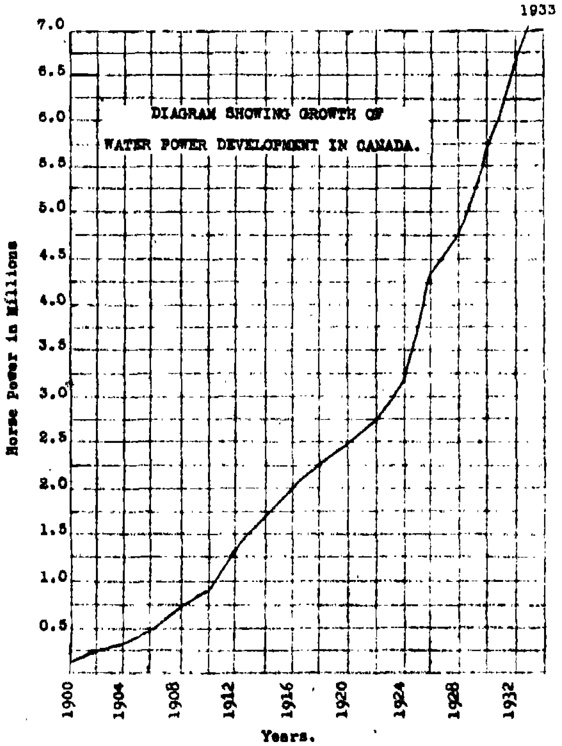

FIG. 1.

The remarkable character of the progress which has been made since the commencement of the present century will be best appreciated by a glance at the graph in Fig. 1, reproduced from the report. In 1900, the quantity of power realised was less than a quarter of a million horse power: it was still less than a million ten years later. By 1920, however, it had reached 2½ millions, and in 1930, 5¾ millions. Between 1928 and 1930, progress was at the rate of half a million horse power per annum, and practically the same rate prevailed up to the beginning of 1932. Last year, there was a slight falling off, but this does not necessarily imply any relaxation of effort, since the additional power is only recorded on completion of the particular undertaking from which it emanates, and anything from two to five years may be required for the execution of individual projects. Various schemes are at present under way, most of which had their inception three or four years ago, before the general suspension, or retardation, of industrial expansion, due to the world-wide financial depression set in. In common with the experience of nearly all countries, there has been of late years a definite decrease in the demand for power, which reached its greatest intensity in the middle of 1931. A recent statement[2] of the Minister of the Interior, the Hon. Thos. G. Murphy, gives, however, a hopeful impression. "More stable conditions," he says, "now appear to have been established, since the figures for the first ten months of 1932 indicate that electric energy produced for use in Canada is practically the same as for the corresponding period in 1931—an encouraging feature being that in August, September and October, the last three months for which statistics are available, an increase has been recorded."

The additional installations brought into operation during the last twelve months were located in five different provinces, but more than 97 per cent of the power was limited to three of them, and the largest of all the installations was made in the province of Quebec. The Beauharnois Light, Heat and Power Corp., Ltd., of Montreal, completed an initial instalment on the St. Lawrence River of 200,000 horse power (Fig. 2), forming part of a programme of half a million horse power designed to be realised in the course of the next few years, with a possible ultimate extension to two million horse power. This notable enterprise was begun in August 1929. It includes the construction of a canal (Fig. 3) about fifteen miles long into which is diverted about a quarter of the flow of the St. Lawrence, which averages some 220,000 cu. ft. per second. In addition to developing hydro-electric power, the new waterway, which is 3,000 feet wide, with a channel for shipping 600 ft. wide and 27 ft. deep, will complete the canalisation for deep-water navigation of all the wholly Canadian sections of the St. Lawrence, with the exception of a single reach round the Lachine Rapids at Montreal. The western entrance is on the southern bank of Lake St. Francis, a mile or two from the town of Valleyfield, whence it follows a wide curve until it enters Lake St. Louis near the town of Beauharnois, where the power house is situated. The fall at this point is 83 ft., representing the total difference in level between the two lakes. The power house contains accommodation for the reception of ten units of generating plant, each of a capacity of 50,000 horse power, and four of these machines are now in operation. Provision has been made for the extension of the building to a length of 3,000 ft., if and when it is called upon to take the entire flow of the river. The cost of the 500,000 horse power scheme has been estimated at a little less than 13 million pounds sterling.

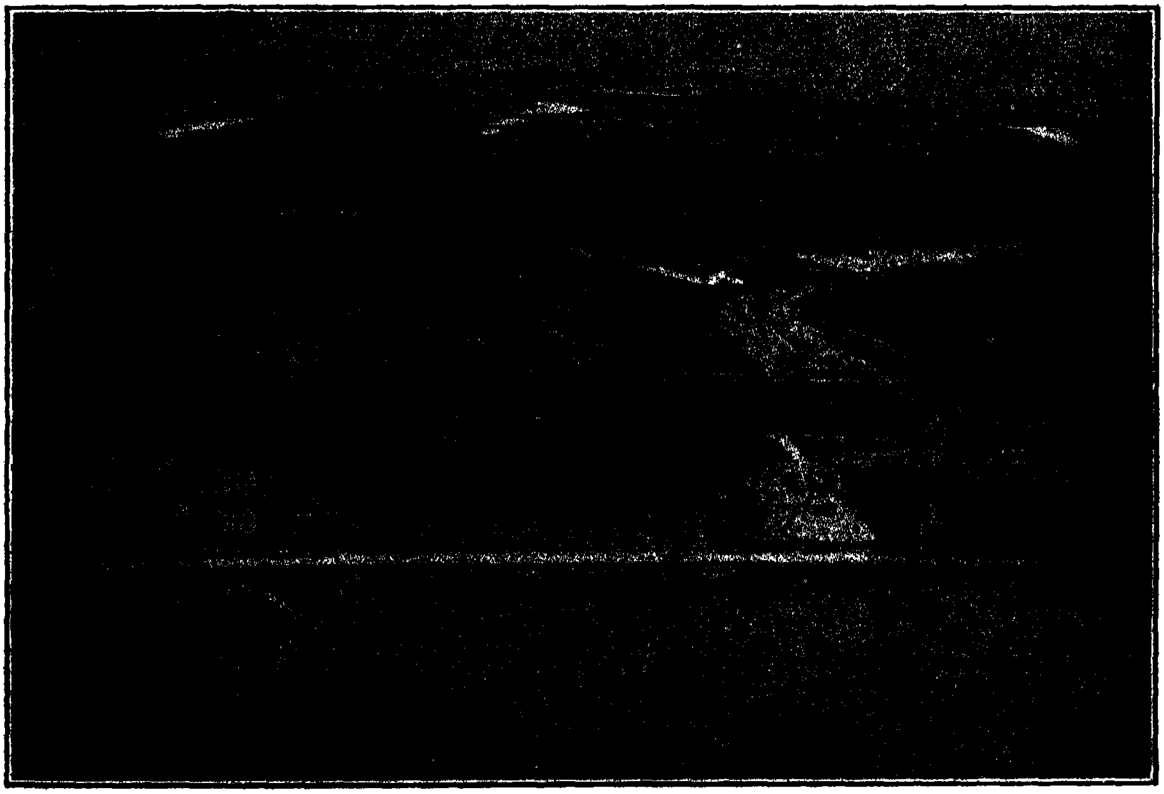

FIG. 2. Beauharnois Development, St. Lawrence River. By courtesy of the High Commissioner of Canada.

The foregoing particulars have been extracted, and the diagrammatic sketch map in Fig. 3 reproduced, by kind permission, from a brochure issued by the Beauharnois Light, Heat and Power Corp., Ltd., of Montreal.

Of the other two major installations, one of 56,000 horse power was the joint development of Chats Falls by the Ottawa Valley Power Co. Ltd., and the Hydro-Electric Power Commission of Ontario, and the second of 57,000 horse power at Corra Linn on the Kootenay River in British Columbia.

The accompanying table, which appears in the report under consideration, shows the available and developed water power in the whole of the Dominion, as recorded on January 1, 1933. The figures in columns 2 and 3 are minimum values, Available and Developed Water Power in Canada, January 1, 1933.

Province	Available 24-hour power at 80 per cent efficiency		Turbine Installation, H.P.
	At ordinary min. flow, H.P.	At ordinary six months flow, H.P.	
(1)	(2)	(3)	(4)
British Columbia	1,931,000	5,103,500	713,792
Alberta	390,000	1,049,500	71,597
Saskatchewan	542,000	1,082,000	42,035
Manitoba	3,309,000	5,344,500	390,925
Ontario	5,330,000	6,940,000	2,208,105
Quebec	8,459,000	13,064,000	3,357,320
New Brunswick	68,600	169,100	133,681
Nova Scotia	20,800	128,300	112,167
Prince Edward Island ..	3,000	5,300	2,439
Yukon and North-west Territory	294,000	731,000	13,199
Total ..	20,347,400	33,617,200	7,045,260

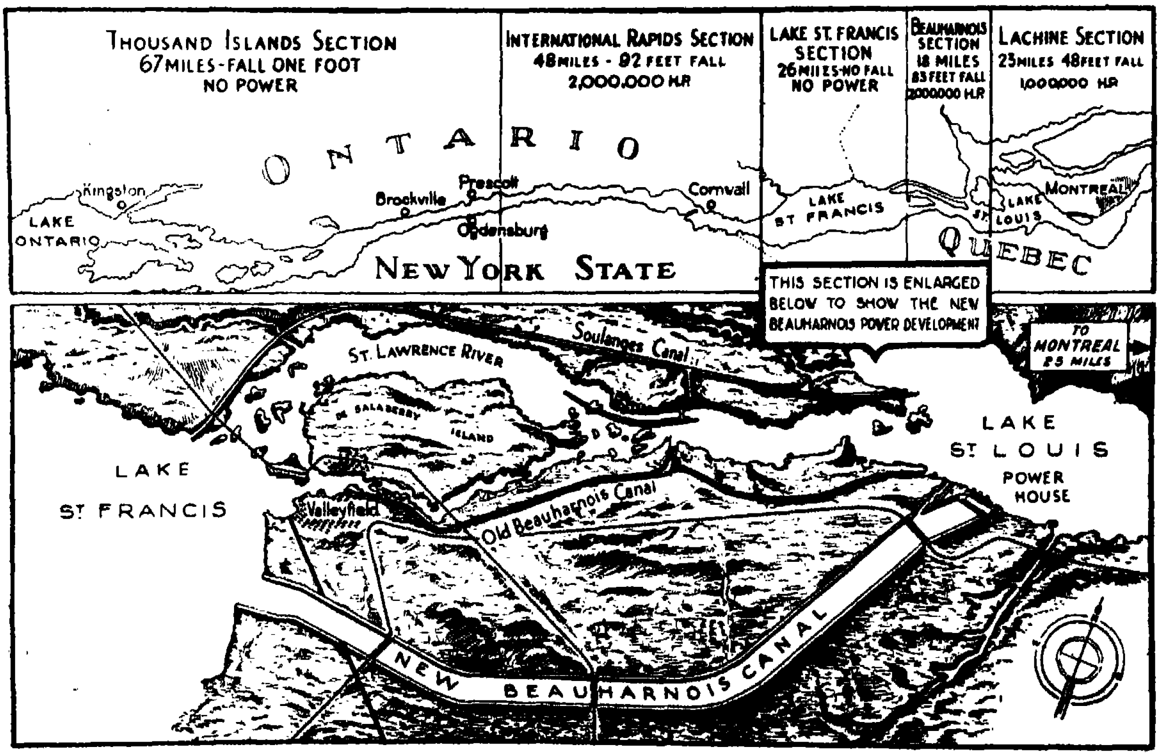

FIG. 3. Sketch map of Beauharnois hydro-electric power development.

and should be increased by 30 per cent if they are to correspond with the values obtained from actual installations. Accordingly, the total potential water power of the country may be reckoned at about 43,700,000 horse power.

It is of interest to form some idea of the economic value of these installations in saving of fuel. The coal equivalent of water horse power is not altogether easy to determine for lack of definite information about operating conditions of individual plants, but basing a comparison on fuel power elsewhere, a conservative estimate, under current conditions, indicates that, if operated continuously throughout the year, each installed horse power would effect a saving of approximately $5\frac{1}{18}$ tons of coal, so that the present aggregate installation of more than 7 millions horse power is capable of producing an economy of more than 35 million tons of coal per annum.

The actual saving in any year depends, of course, upon the actual kilowatt hour output of the plants during the year. Based upon the actual output of central electric stations, it is estimated in the report under consideration that the equivalent electrical production of the total water power installation in 1932 was approximately 18,300,000,000 kilowatt hours. Applying to this a moderate figure of 1·55 lb. of coal per kw.h. (based upon the average consumption of coal and coal equivalent per kw.h. during 1930 by all plants in the United States producing electricity for public use) there is indicated an actual saving for the year 1932 of more than twelve million tons of coal.

In view of the outstanding economic value of its water resources, it is not surprising that the capital invested in the various undertakings should exceed that invested in any other manufacturing industry of Canada. It is computed on a conservative basis that the aggregate amount of the capital involved is 1,620 million dollars or about £324,000,000 at par.

The scope for further development is, of course, considerable, and with so many examples of the remunerative value of this class of undertaking, progress bids fair to be continuous at a rapid rate for a number of years to come. Little more than 16 per cent of the total potential power is yet harnessed.

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[1] "Water Power Resources of Canada." Bulletin No. 1623.

[2] "Hydro-Electric Progress in 1932."

Geophysical Prospecting

IN prospecting for minerals, oils, water, etc., use can be made of the physical characteristics of the materials near the earth's surface. The methods at present adopted can be divided into four groups. The first group utilises the magnetic susceptibility of the materials, the second their density, the third their elasticity and the fourth group comprises various electric methods. The second group comprises the 'gravimetric' methods and the third the 'seismic'. In some cases two or more methods can be applied to the same area and so unwanted factors can be eliminated. The gravimetric method was made possible in 1888 when Baron von Eötvös published his work on the torsion balance. In 1914 Mintrop demonstrated experimentally the possibilities of the seismic methods. Prof. A. O. Rankine discussed the development of geophysical prospecting in his presidential address last year to Section A of the British Association at York.

In a paper read to the Institution of Electrical Engineers on April 7, J. M. Bruckshaw gave a detailed account of the electrical methods of surveying. As a rule, the interpretations of the electrical surveys are of a qualitative nature and in this respect they are not so good as the gravitational and seismic methods, which give indications of the depth and size of the material for which search is made.

There is now a tendency to develop more precise electrical methods with the object of placing them on a quantitative basis. The importance of making a preliminary geological survey and determining the resistivity of samples of the rock in the neighbourhood is now recognised. The results found in this way impose limitations on the use of the various methods that can be applied. If a known mass of ore occurs in the region under test, the interpretation of the results is greatly simplified by conducting the electrical survey directly over the known body.

As an example of the utility of geo-electrical prospecting, the case of a survey made by Mr. Broughton Edge in Cyprus was described. Mineralisation was suspected from the indications of old Roman activities in the neighbourhood. This led to the ground being examined by means of four adits and three shafts, but without result. Within three days of starting the electrical surveys, the centre was plainly indicated by the equipotential lines. The interpretation was confirmed by driving two adits and these encountered a large pyritic mass, the upper end of which lay immediately below the centre. Although the surface of the ground was very rough the equipotential curves on the map were smooth.

In survey work, rocks and minerals are divided into two classes, metallic conductors and electrolytic conductors. Practically all minerals showing metallic lustre are in the first class. In nearly all methods of electrical prospecting, an equipotential line method is first employed as this takes very little time and locates the most promising areas. These areas do not necessarily represent mineral deposits, for bands of clay and graphite-impregnated schists, etc., yield the same type of anomaly as an ore body. In some cases, geophysics may differentiate between a mineral deposit and a band of clay, but it is generally the geologist who determines which of the indications are caused by ore.

The depth to which the ground can be examined depends on the kind of method used. In the resistivity methods, the ground examined penetrates to a depth approximately equal to the distance between the electrodes. With great depths the results obtained are difficult to interpret. As a rule, it is not convenient to use currents greater than five amperes. Good results are sometimes obtained by using high-frequency alternating currents.

Obituary

PROF. VICTOR GOLDSCHMIDT

SCIENCE has to deplore the loss of another of her 'grand old men', Germany one of her most distinguished sons, and the world of culture at large one of the most accomplished, versatile and beneficent of its exponents, in the passing on May 8 of Prof. (Herr Geheimrath) Victor Goldschmidt, honorary professor of mineralogy and crystallography at the University of Heidelberg, at the ripe age of eighty years. His name has long been a household word with the small, but now happily increasing, coterie of workers in crystallography, which he was fond of calling the "Queen of Sciences"; and he was never tired of expressing his intense delight in the wonderful beauty of crystals. Yet so wide were his interests that in many other subjects he was almost equally distinguished, particularly ethnography, astronomy, physiology, colour in art, and tone and harmony in music. Having inherited great wealth—sadly depleted afterwards by the War—he was able to advance the interests of his subjects to an exceptional degree, and became a 'pious founder' in the truest sense of the term.

Born in Mainz on February 10, 1853, of Jewish stock, in the year 1871 he became a student of the Gewerbakademie of Berlin. Then from 1872 until 1878 he attended the celebrated Bergakademie of Freiberg, and during his last three years there acted as an assistant. In order to acquire further experience, however, he migrated in 1878 to the School of Mineralogy and Crystallography then growing up in Munich, which later became so famous under the guidance of Prof. von Groth; afterwards, in 1879, he went on to Heidelberg, where he took his degree of doctor of philosophy in 1880.

Prof. Goldschmidt had the inestimable advantage of the life-long help of a devoted and highly intellectual wife, a first cousin (formerly Fräulein von Portheim), who was both a remarkable linguist and keen appreciator of music and art in all its branches. Their home in Heidelberg, where they lived very simply and unostentatiously, but where they literally lavished hospitality and kindness on their many foreign visitors, was replete with valuable art treasures, such as Italian illuminated manuscripts, very early examples of printing, ancient French *objets d'art*, gems of every kind and a wonderful collection of crystals.

The laboratory of Prof. Goldschmidt at Heidelberg is a private one, which was provided and maintained at his own expense, but with the full concurrence of the University. He usually had working there, under his direction and that of his assistant Dr. Himmel, in mineralogy and crystallography, some ten to fifteen students, and also another half-dozen of more experience engaged in research, either for their doctorates or in a still more mature class of investigation. To this remarkable institution were attracted students possessing some previous experience from all over the world, including quite a number from England (especially Oxford and Cambridge) who were always warmly welcomed. Eventually in 1916 Prof. and Frau Goldschmidt definitely endowed the laboratory, together with an Institute for Folk-lore, and an ethnographical museum which they had also provided, as the "Josefine und Eduard von Portheim Stiftung für Wissenschaft und Kunst", in honour of their parents, Prof. Goldschmidt's mother and Frau Goldschmidt's father. Provision was also specially made for an English research bursary of about £150 per annum, to enable an English student of experience and promise but not too well provided with means to work with Prof. Goldschmidt, and incidentally to further friendship between Germany and England. On the eightieth birthday of Prof. Goldschmidt last February, the laboratory was formally named the Victor Goldschmidt Institut für Krystallforschung.

The published scientific papers of Prof. Goldschmidt form an immense list, numbering about 180, many of them masterpieces on specific minerals. Besides these papers he produced in the years 1914–26 the "Beiträge zur Krystallographie und Mineralogie", and since 1922 the "Heidelberger Akten der von Portheim Stiftung", and the "Materialen zur Naturphilosophie". Perhaps his most valuable contributions concerned blowpipe methods, which he carried to perfection, for the determination of minerals; crystal measurements by the theodolite method (azimuth and polar distance), using the two-circle goniometer which he perfected; and crystal drawing and calculation from the gnomonic projection, which he considerably elaborated. When we add to these his papers on etch- and solution-figures on crystal faces, his "Index der Krystallformen der Mineralien", his "Krystallographische Winkeltabelle", and last but not least his monumental "Atlas der Krystallformen" (1923) in nine volumes of figures and a like number of volumes of text, which took many years to complete, it will be obvious what a magnificent addition to our knowledge Prof. Goldschmidt has left behind him.

On the occasion of his seventy-fifth birthday Goldschmidt was presented with a "Festschrift", containing thirty-three original papers on mineralogy and crystallography, entirely contributed by his old students and a few personal friends; they included one from the late Dr. T. V. Barker of Oxford, and another by Dr. Mary Porter of the same University, who had received great kindness from Prof. Goldschmidt and his wife during the period of her work at his Heidelberg laboratory before the foundation of the bursary. It was published by the von Portheim Stiftung, under the editorship of Dr. Himmel, and with a foreword of appreciation of Prof. Goldschmidt's work by Prof. Milch. Prof. Goldschmidt was an honorary member of the Mineralogical Society in Great Britain, and of a dozen other scientific societies outside Germany.

Last December and January, Prof. and Frau Goldschmidt were in England, staying with the former's brother in London, and although when visiting the Master of Pembroke and Mrs. Hutchinson in Cambridge he appeared to be wonderfully vigorous, yet his relatives were then very anxious about his health. On leaving England they did not return home, but travelled to Salzburg in Austria, and before long it became necessary to remove from the hotel to a sanatorium, where Dr. Goldschmidt rapidly became worse, and where he died, as stated, on May 8. The recent happenings to his many Jewish friends in Germany cannot fail to have distressed him, and to have been a source of unhappiness during his last days. Yet he sought to find solace in planning further researches, and especially in compiling a review of the present position of crystallography, so as to discover the lines along which future research might most advantageously be prosecuted.

Unselfish to the end, Goldschmidt's thoughts were ever with the great institution which he had founded in Heidelberg, and now that he has been taken home and buried in that lovely spot by the banks of the Neckar, on the scene of his great life-work, we can only hope that the Stiftung and its traditions and especially the Victor Goldschmidt Institute for Crystal Research will be cherished as the worthiest memorial possible of this truly great man of science and perfect kindly gentleman. May his spirit inspire those who work there to emulate the master, and thus to produce further contributions of real value to our knowledge of the subject, the study of crystals, that was nearest his heart! A. E. H. TUTTON.

News and Views

Prof. Robert Chodat

THE recipient of this year's Linnean Medal awarded by the Linnean Society of London is Prof. Robert Chodat of Geneva. Unfortunately, he was unable to be present at the anniversary meeting held on May 24 and the medal was received on his behalf by the Swiss Minister. In the present state of specialisation, it is difficult to cover much of the field of botany and Prof. Chodat is one of the very few who can be considered a master in most branches. His work on the systematics of Polygalaceæ and their geographical distribution, and his ecological accounts of the vegetation of Paraguay explored by him in 1914 and of Portugal, Spain and Majorca which he visited with his students, are of great merit. In his laboratory at Geneva he elaborated the methods of obtaining pure cultures of Algæ now in general use, and his papers on Algæ, culminating in his monograph on polymorphism, have made him a recognised authority on the subject. More recently he has turned his attention to Fungi, particularly the organisms of fermentation, where his knowledge of chemistry and physiology has enabled him to make important advances. It is not so much the minutiæ of a subject as the broad principles that have attracted him, as is seen in his critical study of the palæozoic Pteropsida and in his address on the conception of species in modern botany. In genetics his contributions, though not numerous, have been fundamental. It is natural that he should be a successful teacher and his admirable "Principes de Botanique" reveal his wide and philosophic outlook. Geneva has always been famous for its botanists and Robert Chodat is a worthy successor to de Saussure and the de Candolles.

Prof. William A. Bone, F.R.S.

Prof. William A. Bone, of the Imperial College of Science and Technology, South Kensington, has been awarded the medal of the Society of Chemical Industry in recognition of his researches into the mechanism of combustion. This medal, which was instituted in 1896, is awarded periodically for conspicuous service rendered to applied chemistry, by research, discovery, invention or improvements in processes. It was in 1898, when Prof. Bone was lecturer in chemistry and metallurgy at Owens College, Manchester, that he started systematic research on the combustion of hydrocarbons and the influence of hot surfaces in promoting gaseous combustion, for which research he was elected a fellow of the Royal Society in 1905. In 1911 he was awarded the Howard Potts gold medal of the Franklin Institute of Philadelphia. In 1912 he began to organise and direct the new Department of Chemical Technology at the Imperial College, South Kensington. Prof. Bone's researches have comprised the chemical constitution of coal, surface combustion, gaseous combustion and explosions under high pressure, the photographic investigation of flame propagation during gaseous explosions, the combustion of hydrocarbons and blast furnace reactions. A lecture on July 12 entitled "Forty Years of Combustion Research" by Prof. Bone is one of the features of the annual meeting of the Society of Chemical Industry to be held in Newcastle on July 10–14.

Academic Assistance Council

THE present state of affairs in universities in Germany has raised in acute form the position of many scientific workers who, by reason of race, religion or political views, are unable to carry on their investigations in their own country. While no doubt universities in other countries will offer facilities to such displaced workers, it must be remembered that their resources are limited and in most cases already allotted. An Academic Assistance Council has therefore been formed in Great Britain, to co-operate with similar bodies in other countries in collecting funds to provide maintenance for displaced university teachers and investigators and in placing them in universities and institutions where they will be able to pursue their work. An appeal for funds, addressed to "all who are concerned for academic freedom and the security of learning", and signed by distinguished men of science and letters, has been issued, in which it is emphasised that the formation of the Council implies no reflection on political issues in other countries but is solely an attempt to relieve suffering, prevent waste of valuable talent and defend learning. The Royal Society has placed office accommodation at the disposal of the Council, and Sir William Beveridge and Prof. C. S. Gibson are acting as honorary secretaries. Communications and contributions should be sent to them at the Royal Society, Burlington House, London, W.1.

The Old Ashmolean, Oxford

THE celebrations, arranged by Dr. R. T. Gunther, of the two hundred and fiftieth anniversary of the opening of the Old Ashmolean on May 21, 1683, brought together a large gathering, which included representatives from a number of universities and scientific institutions in Great Britain and the United States. The Royal Society and the Linnean Society sent messages of congratulation, the latter referring particularly to the original specimens of the Tradescants forming part of the Lewis Evans collection. On May 21, a private reception was held in the Old Ashmolean building by Dr. R. T. Gunther. The guests took tea afterwards in Exeter College Hall, following the route taken by the Duke of York and his retinue in 1683, after the original opening of the Museum. On May 22, a private luncheon-party assembled in Wadham College Hall, and a toast in memory of Elias Ashmole was submitted. Sir Frederick Gowland Hopkins, who was among the guests, referred to the desirability of a fuller realisation of the value of historic science as an intellectual equipment and implement in current methods of education. In the course of the afternoon a lecture was delivered in the University Museum by Sir Arthur Smith Woodward on "Plot and Lhwyd and the Dawn of Geology". A survey was given of the position of natural science in Great Britain and in other European countries in the seventeenth century. The studies of Plot and Lhwyd were described. From the preface of the former to his work "The Natural History of Oxfordshire: an Essay towards the Natural History of England" (1677), it would appear that Plot was of vigorous temperament. He says: "But as for the hot-headed, half-witted Censurer, who, perhaps, only looks on the Title of a Chapter, or here and there a paragraph that makes for his turn, I must and do expect the lash of his tongue." The exhibition of objects of Ashmolean interest—especially those at the Bodleian Library in relation to Ashmole himself, and of great historic value—were a welcome form of dedication accompanying the celebrations.

The Neutron

THE Bakerian lecture of the Royal Society was delivered on May 25 by Dr. J. Chadwick, who took as his subject "The Neutron". Neutrons can be liberated by the bombardment of several light elements by α-particles, but, except from beryllium and boron, the yield of particles is very small. In some cases the experiments are consistent with the conservation of energy and momentum in the reactions. With beryllium, however, it is at first sight difficult to account for the whole of the energy available in the disintegration. From the data now available, the mass of the neutron is consistent with the view that the neutron is a complex particle formed by the union of a proton and an electron. Other arguments suggest that the neutron is an elementary particle. As an alternative, one might suppose the proton to be complex, consisting of a neutron and a positive electron, but this view also has certain difficulties. Dr. Chadwick dealt with experiments on the passage of neutrons through matter. Some interesting points appear in the collisions with the lighter nuclei, in particular with protons. In some cases inelastic collisions have been observed in which the atomic nucleus is disintegrated. When the radiation from beryllium, consisting of neutrons and γ-rays, passes through matter, positive electrons are occasionally produced. It is not yet known whether these are due to the action of the neutrons or to the γ-rays. The function of the neutron in the structure of atomic nuclei was also discussed.

Crested Rat at the London Zoo

THE authorities at the gardens of the Zoological Society have been fortunate in securing four specimens, from Kenya, of that most curious and rare rodent the 'crested rat' (*Lophiomys imhausi*); no specimen of this animal has ever before been exhibited in captivity, though it has long been known to science, having been described by Milne-Edwards so long ago as 1867. Though termed as 'rat', it has really no very close relationship to this animal. Indeed, owing to its many structural peculiarities it has been made to constitute a family by itself—the Lophiomidæ. Nor is it at all accurately described when it is said to be a "badger-like animal", for it bears no very close resemblance to any other known rodent. One of its most characteristic external features is the great crest of long coarse hair which surmounts the back, bordered on each side by two bands of white. The nature and function of a glandular tract running down from the nape tail-wards, along the back, has yet to be discovered. Until now, nothing was known of the young. But one of the new captives, since its arrival, has given birth, not to a litter, as one would have expected of a rodent, but to a single young one, and this has elicited a further fact new to science, since it was born with a coat of fur, and not naked as with other rodents. The fact that this animal is arboreal is not likely to have any connexion with this unusual condition of the new born young, and the fact that but one is produced at a birth.

Research in the Paint and Varnish Industries

ON May 25 the Research Association of British Paint, Colour and Varnish Manufacturers held an exhibition at its Research Station, Waldegrave Road, Teddington, Middlesex. The firms comprising the Association's members range from those concerned with the manufacture of linoleum to the manufacturers of printing inks and of polishes, the main body conforming in interests with the title of the Association. In the six years that the Association has been actively engaged in researches, this wide range of interests has necessarily given rise to a large number of apparently unrelated investigations. The industries concerned, however, all have to deal with the properties of fluids, of thin films, of pigments and with the inter-relations between the pigment and an embedding medium. The work on view on May 25 included new apparatus and technique for the measurement of the hiding power of pigments, of the gloss of surface films and of the tinting, fastness and bronzing characteristics of pigments, the rate of evaporation of volatile constituents from thin films, the reactions of detached films of paints, varnishes and lacquers to a steady load, a rapidly increasing load, and an alternating load. New methods of evaluating the technical utility of linseed, tung and other vegetable oils were on view, as well as small-scale manufacturing plant suited to the production of all types of varnishes, lacquers and paints. The very rapid recent advances in the field of synthetic resins were reflected in a series of chemical studies of the mechanism involved in the complex polymerisation processes on which the manufacture of these materials is based. In the field of pigment manufacture, several important advances in technique recently originated at the Research Station were on view. These concern improvements in dispersion of organic lakes, greatly increased resistance of lead chromes to photo-chemical and chemical influences and the treatment of prussian blues to overcome some of their usual defects from the point of view of dispersibility.

IN the afternoon, Dr. W. Krumbhaar, director of the corresponding German organisation, Institut für Lackforschung, Berlin, gave two interesting addresses on the subjects "No Illusions about Chlorinated Rubber" and "Commercial and Scientific Activities of the Paint Industry in England and Germany", to a large audience in the library at the Research Station. Among the many points of technical interest dealt with by Dr. Krumbhaar was his reference to the fact that, in Germany, a scientific man is regarded as having at least as much business acumen and ability as has his non-scientific confrère. It was evident from Dr. Krumbhaar's description of the activities of his own Institute that, in addition to carrying out a wide range of scientific investigation, a considerable amount of effort is expended in educating the German paint and varnish industry as to the details of various government restrictive orders and in protecting them from the evil effects of misuse of the patent system by large suppliers of their raw materials.

Leverhulme Research Fellowships

BY the will of the first Lord Leverhulme, who died in 1925, the income arising from a part of his estate is to be devoted to the provision of scholarships for "research and education". The trustees have now resolved to devote £12,000 a year to the establishment of a scheme of research fellowships. The fellowships are primarily intended to assist experienced research workers rather than workers in an early stage of their careers. The duration of the grant will normally not exceed two years. Fellows may work either at home or abroad and no subject of inquiry is excluded from the scope of the scheme. The advisory committee is constituted as follows: Dr. H. J. W. Hetherington (chairman), Prof. A. M. Carr-Saunders, Sir William Hardy, Dr. N. V. Sidgwick, and Mr. H. T. Tizard. Dr. L. Haden Guest has been appointed secretary. Applications (from British-born candidates normally resident in the United Kingdom) and all inquiries and communications in connexion with the scheme should be addressed to the Secretary, Leverhulme Fellowship Scheme, Union House, St. Martin's-le-Grand, London, E.C.1. It will be a convenience to the committee if as many applications as possible are in the hands of the secretary by June 19.

Recent Acquisitions of the British Museum (Natural History)

ACQUISITIONS for the Department of Zoology include a series of elephant skulls from the Gola Forest, Sierra Leone, the gift of His Excellency the Governor of Sierra Leone. These skulls are of great scientific value as they demonstrate the existence of a small race of elephant in West Africa. Dr. G. H. Rodman has presented a series of stereoscopic radiographs of Mollusca shells for exhibition. Among the donations to the Department of Geology is a large collection from Miss M. S. Johnston, mainly of Silurian fossils from England and Norway. A portion of a meteoric stone which fell on July 8, 1932, at Kahrapar, Jaunpur, United Provinces, India, has been presented to the Department of Minerals by Mr. H. Minson. A collection of Coleoptera belonging to the family Curculionidæ and numbering approximately 40,000 specimens, has been deposited in the Department of Entomology as a "permanent loan" by the Hawaiian Sugar-planters' Association of Honolulu. The collection, which is representative of the weevils of every part of the world, was brought together by the late Dr. David Sharp, after his first and largest collection of beetles had been acquired by the Museum in 1905. His British collection was acquired in 1932.

THE Department of Botany has had bequeathed to it the herbarium of Mr. James Groves, who was the recognised authority on Charophyta (stoneworts) and one of the best-known field botanists of Great Britain. He worked for many years in collaboration with his brother Henry, and together they edited the ninth edition of Babington's "Manual of British Botany". Henry died in 1912 and in 1918 a first consignment (6,000) of their British plants was presented to the Department. James later wrote the Ray Society's monograph on Charophyta with Canon Bullock Webster as joint author. The bequest includes more than 6,000 Charophyta and about 11,000 British flowering plants: the remainder are mosses and sea-weeds. All are well and carefully mounted ready to be incorporated in the herbarium. Dr. R. J. D. Graham, of the University of Edinburgh, has presented his collection of about 1,300 Mesopotamian plants made by himself and others. An account of the plants will appear shortly in "Notes from the Royal Botanic Garden, Edinburgh". The Sladen and Godman Trusts have presented about 900 plants recently collected on the Islands of the Gulf of Guinea by Mr. A. W. Exell, assistant keeper in the Department, in company with Mr. W. H. T. Tams, of the Department of Entomology. The islands visited were Fernando Po, Principe, São Thomé and Annobon, from which there was little material previously in the herbarium. The collections from Fernando Po were practically confined to the Inoka region in the south, a country with a most interesting vegetation unique in tropical Africa. There are many new records of plants and several new species. The collections will probably enable a general account of the geographical relationships of the four islands to be written.

Chemistry and the Art of Living

ON March 24 Prof. H. E. Armstrong delivered the Sir Jesse Boot Foundation lecture in the lecture theatre of University College, Nottingham. Recalling the fact that one of the most pleasant memories of his life was the hours spent under the roof of Sir Jesse and Lady Boot, he paid tribute to the quality that belonged to his late host and claimed that, in founding the chair of chemistry, Sir Jesse Boot did a service to his fellow citizens which will ultimately save them from themselves: providing they be taught the proper art of living, which will soon be the duty of chemistry. When this is achieved, "cash chemists" may cease to exist, as drugs are only used to counteract inborn faults in the human machine and insufficient food, deficiencies in food, effects of over-feeding or improper feeding, zymotic disease.

Hence the future lies with the farmer, who will have to produce not only the food that we desire but also that which we ought to have in a perfect condition. To do this, the farmer will have to feed his animals properly and this necessitates a great extension in the use of fertilisers on the land. Thus it appears that the "cash chemist" returns to action with a change of function—to supply the farmer with his chemical manures. Prof. Armstrong was despondent at the delay in reaching this condition of a brave new world and concluded with the following words: "at the moment our failure to use intelligence, the world over, is astounding—some fault there must be in developing it. A few months ago in a speech in this city I suggested clearing out the present race of students and their teachers and bringing in 500 chosen boys who could be trained as cooks. I would repeat my advice to-day but add that to cook should mean to understand what is cooked, what is fit and proper to be eaten, as well as the mere art of kitchenry. We cannot get away from the fact that we live always through our stomachs; from these it is, through the food we put into them, that we gain and have our being."

Electric Welding in Ship Construction

ELECTRIC welding, instead of rivetting, is being widely adopted in shipbuilding. In German naval dockyards it has practically superseded rivetting. Electrically welded ships have practically no leakage and there is little corrosion or wastage of plates around the welded joints. Economies are effected by welding in the weight and cost of a ship's hull. The welded ship therefore yields greater service for a smaller investment of capital. The University of Glasgow has introduced welding work into its laboratories and the design of welding joints has been introduced into all its engineering courses. The Glasgow Education Committee is also taking steps to form a new skilled class of workmen called ship welders. Before a change of this kind can be made it is necessary for the employers and the trade unions to meet. In the *Times* of May 26 an account is given of a conference held in Edinburgh between employers' federations and trade unions on this subject. Mr. J. B. Hutchison, the chairman of the employers, stated that it is of the greatest importance that the development of welding should proceed as rapidly and smoothly as possible in Great Britain on economical lines in order that competition with other shipbuilding nations may be successfully faced. It is understood that the employers made it clear that the selection of ship welders is likely to be made from the most suitable men, not confined to any one class and not necessarily from men directly displaced by the new process. Mr. Sherwood, on behalf of the unions, said that the proposals were of such a far-reaching character that full and careful consideration was necessary.

Electrical Equipment of the *Queen of Bermuda*

IN the G.E.C. (General Electric Co.) *Journal* for May there is a full and interesting description of the electrification of the Furness-Withy liner, *Queen of Bermuda*. It was launched at Barrow-in-Furness last February and has successfully completed its trials. Its tonnage is 22,500 and its shaft horse power is about 20,000. Electricity is used on the most extensive scale possible throughout the ship. It is used for the propulsion and steering of the ship. It is also used for lighting and ventilation, cooking, refrigeration, the handling of cargo, and there are eleven electric lifts, etc., the auxiliary machinery totalling about 3,000 horse power. For maintaining a supply of power adequate for essential services in cases of emergency, an oil-engine-driven dynamo of 50 kilowatts capacity is installed on one of the upper decks well above the water line. The change over of the panic-lighting circuits from the emergency busbars to a battery is entirely automatic and takes place on the failure of the supply voltage. The vessel is intended primarily for service between New York and Bermuda but she has been constructed for ocean-cruising as well. In view of the large amount of perishable foodstuffs which have to be carried, extensive refrigerating plant is provided. For this purpose, 23 motors are required, the largest being of 70 horse power for driving a carbon dioxide compressor. The lighting is done on a very lavish scale, requiring 450 kilowatts of electric energy. It is mainly effected by concealed lighting in opaque cornices, diffused lighting through continuous glazed cornices, or box lights glazed with tinted diffusing glasses in modern designs. For illuminating the dancing space three-colour lighting is used for the main ceiling. The lights are controlled by dimmers when dancing is in progress so as to produce a pleasing variation in the colour of the illumination. This is a great improvement on 'jazz' lighting.

Freshwater Biological Association

THE annual general meeting of the Freshwater Biological Association of the British Empire was held on May 11 in the rooms of the British Waterworks Association, Grand Buildings, Trafalgar Square, W.C.2. The following officers were elected for 1933–34:—*President*, Mr. Reginald Beddington; *Chairman of Council*, Prof. F. E. Fritsch; *Hon. Treasurer*, Mr. Nigel O. Walker; *Hon. Director of the Laboratory*, Dr. W. H. Pearsall; *Hon. Secretary*, Mr. J. T. Saunders. The report of the Council showed that considerable progress has been made in fitting out the Laboratory of the Association at Wray Castle at Windermere. Tables are now available for visiting research workers and accommodation for these workers is provided in the Castle. Subscriptions have been received from a wide circle interested in freshwater problems. Subscriptions, renting tables at the Laboratory, have also been received from universities, many of which have already nominated research workers to occupy their tables at the Laboratory. The Council is anxious to provide the fullest possible facilities at the Laboratory for those who wish to work on freshwater problems. The most pressing need at the moment is the provision of an electric supply for the Laboratory, but the Council has at present no funds to supply this need. The address of the honorary secretary of the Association is Mr. J. T. Saunders, Christ's College, Cambridge.

Australian Water Supply

THE water supplies of certain parts of Australia, and the occurrence of periodic drought, are the subject of comment by Dr. J. P. Thomson in an article in the *Sydney Morning Herald* of January 12. As a result of observations ranging over half a century, Dr. Thomson believes that there are unmistakable signs of desiccation and he advocates the immediate necessity of measures to preserve the water supplies and to resist the ill-effect of droughts. He points to observations on Lake George and various lagoons in the eastern part of New South Wales as well as Lake Eyre as showing rapid deterioration in humidity. The wells of the great artesian basin, according to him, are showing signs of decreased flow which he attributes to the plutonic and therefore limited supply of the water. He points also to the decreased flow in many water courses and the serious loss of water by excessive evaporation in the dry atmosphere. Dr. Thomson would like to see every effort to conserve water by preventing waste of flood water and checking the number of wells, and he favours also the preservation of fodder against times of stress. He points also to the urgent need of better weather forecasts, which he thinks must come from the antarctic, in order to give the farmer warning of any surplus or deficiency in rainfall. Measures such as these might go hand in hand with more land settlement and production for wider markets.

Russian Arctic Expeditions

IN recent years the Soviet Union has paid a great deal of attention to the exploration of its arctic territories and the investigation of commercial sea routes north of Siberia. The Society for Cultural Relations between the Peoples of the British Commonwealth and the U.S.S.R. has recently directed attention to the activities of Soviet arctic expeditions in 1932. Most important were the establishment of observatories at Cape Chelyuskin, at Rudolph Island in Franz Josef Land, in Novaya Zemlya and at the mouth of the Lena River. The Rudolph Island station is to be the base of a thorough exploration of Franz Josef Land and the little-known seas to the east. Several ice-breakers were engaged in hydrographical work in the Barents and Kara Seas while the *Sibiriak*, which made the north-east passage from Archangel to Bering Strait, reports that ice congestion in the western part of the passage can be avoided by passing north of Northern Land. It is by no means certain, however, that this route could be relied on every year in maintaining communication between White Sea ports and the Lena River, though the possibility is worth investigating.

Annales Guébhard-Séverine

WE have received No. 8 of these annals, which have been issued yearly since 1925 by the Institut Guébhard-Séverine, 4 Rue du Seyon, Neuchâtel, Switzerland, and are distributed free on application to the Institut, to investigators in all countries. The Institut is also willing to publish scientific works written in any of the languages French, English, German or Italian; its practice appears to be to translate into French for publication. Papers on subjects studied by the late Adrien Guébhard are particularly invited; these subjects include geophysics and geology, botany, electricity, hydrodynamics, osmosis, biological physics, meteorology, acoustics, photography and spectroscopy. The present number of the annals contains four papers, by R. Reinicke on the tetrahedral field of action of atoms, by F. Strunz on the natural sciences in the work of Albertus Magnus, by L. Courvoisier on researches to determine the 'absolute' motion of the earth, and by D. Chahnazaroff on petroliferous waters.

Institute of Physics

THE recently issued annual report for 1932 of the Board of the Institute of Physics shows a satisfactory record of work during the year. There has been a steady increase in membership of the Institute which now has about seven hundred names on its roll. The local sections, too, in Australia and India, report a successful year. During the year, a local section was formed at Manchester under the chairmanship of Prof. W. L. Bragg with Dr. H. Lowery of the Physics Department of the University as local secretary. The following officers among others have been elected for the session 1933–34: *President*, Sir Henry Lyons; *Treasurer*, Major C. E. S. Phillips; *Secretary*, Prof. J. A. Crowther.

Third International Congress of Experimental Cytology

THE third International Congress of Experimental Cytology will be held at Cambridge on August 21–26. The international president is Prof. Th. Huzella, professor of anatomy in the University of Debrecen, whose presidential address will be entitled "Culture des tissus en ses relations aux problèmes générales de la biologie et aux problèmes speciales de la médecine". The chief feature of the Congress will be discussions on the following topics: "Cell Respiration and Cell Metabolism"; "Cell Form and Function as demonstrated by Recent Advances in Tissue Culture"; "The Electro-Physiology of the Cell"; "Entwicklungsmechanik und Explantation"; "The Cultivation of Animal and Plant Viruses". Papers will be presented by authors from Great Britain, Germany, Austria, Hungary, U.S.S.R., United States, Poland, Italy, Holland, Czechoslovakia, France, Switzerland, Denmark, and Japan. Among the distinguished foreign visitors will be Prof. H. Wieland (Munich), Prof. A. Szent-Györgyi (Budapest), Prof. R. Chambers (New York), Prof. W. J. V. Osterhout (New York), Prof. J. Michaelis (New York), Prof. S. C. Brooks (Berkeley), and Dr. K. Landsteiner (New York). Further information concerning the Congress can be obtained from Dr. Honor B. Fell, Strangeways Research Laboratory, via Cherryhinton, Cambridge.

Twenty-fifth Anniversary of the French Society of Physical Chemistry

A PROGRAMME has now been arranged for the meetings which are to celebrate the twenty-fifth anniversary of the French Society of Physical

Chemistry, to which reference has already been made in these columns (Jan. 14, p. 53). Two general discussions will be held on Oct. 16–22, on "The Electron Theory of Metals" and on "Electrolytes and Boundary Layers (Electrode-Solution)". Among those who have already promised contributions to the discussions are Prof. Brillouin (Paris), F. Bloch (Leipzig), Prof. V. Henri (Liège), Prof. Joffé (Leningrad), Prof. E. K. Rideal (Cambridge), Prof. M. Volmer (Berlin), Prof. P. Debye (Leipzig), Prof. P. Dutoit (Lausanne), R. Audubert (Paris), Prof. F. Dubois (Clermont-Ferrand), A. H. Wilson (Cambridge), Prof. A. Gillet (Liège), Prof. O. Scarpa (Milan), Prof. Denina (Turin), Prof. J. Heyrovský (Prague). Notification of proposed attendance at the meeting should be sent as early as possible to the General Secretary of the Society, Dr. Ch. Marie, 9 rue de Bagneux, Paris (VI). The registration fee is 125 francs, including reception, banquet, excursions, etc., as well as advance copies of papers for discussion. Advance proofs will be forwarded immediately to those who pay their registration fee before June 30; others will receive them at the meeting in October.

Sixth Imperial Social Hygiene Congress

THE sixth Imperial Social Hygiene Congress will be held at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1 on July 3–7 under the presidency of Sir Basil Blackett. On July 3, the presidential address will be delivered, and the rest of the Congress will be divided into a series of discussions including such topics as the effect on established social customs of modern knowledge and economic conditions; changes in the outlook on prostitution; biology and health—the teaching of biology in schools and colleges; conference of teachers of biology; methods of dealing with venereal disease in the defence forces of different nations; the training, etc., of health visitors, nurses and midwives; venereal disease administration and the supply of educational and cultural films. Progress reports from Great Britain and the Dominions concerning different branches of social hygiene will be presented at the Congress. Arrangements have been made for visits to various institutions of interest to the delegates, a special display of films, and an exhibition of simple equipment used in biological teaching. Further information concerning the Congress can be obtained from the Secretary, British Social Hygiene Council, Carteret House, Carteret Street, London, S.W.1.

Announcements

AT a meeting of the Royal Society held on May 25, the following were elected foreign members of the Society: Prof. Vilhelm Friman Koren Bjerknes, of the Physical Institute of the University of Oslo; Prof. Harvey Williams Cushing, of New York, distinguished for his work on the surgery of the brain; Prof. Peter Debye, professor of physics in the University of Leipzig; Prof. Friedrich August Ferdinand Christian Went, professor of general botany in the University of Utrecht.

THE annual visitation of the National Physical Laboratory will take place on June 27 from 3 to 6 p.m.

THE RIGHT HON. LORD MELCHETT has consented to accept the presidency of the British Science Guild in succession to the Right Hon. Sir Samuel Hoare, whose three-year term of office ends this month. Lord Melchett will be elected president of the Guild at the annual general meeting to be held in the Mansion House on June 19 at 4.30 p.m. when the Right Hon. The Lord Mayor of London (Sir Percy W. Greenaway) has kindly agreed to take the chair.

AT the anniversary meeting of the Linnean Society of London held on May 24 the following were elected officers of the Society:—*President*, Prof. F. E. Weiss; *Treasurer*, Mr. Francis Druce; *Botanical Secretary*, Mr. John Ramsbottom; *Zoological Secretary*, Dr. Stanley W. Kemp.

THE annual general meeting of the British Science Guild will be held in the Mansion House, London, E.C.4, on June 19, at 4.30 p.m., when the chair will be taken by the Right Hon. the Lord Mayor of London. The meeting will be followed by a popular lecture entitled, "Some Problems of British Forestry", by Prof. R. S. Troup, professor of forestry in the University of Oxford and director of the Imperial Forestry Institute.

APPLICATIONS are invited for the following appointments on or before the dates mentioned:—An assistant lecturer in mathematics at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (June 12). A director of research at the Forest Products Research Laboratory, Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S.W.1 (June 22). A lecturer in pathology at the University of Liverpool—The Registrar (June 24). A head of the Manual Training and Engineering Department of Christ's Hospital, Horsham—The Headmaster. An assistant lecturer in agricultural botany at the University of Reading—The Registrar. A part-time teacher of bakery science (especially elementary physics and chemistry) at the Borough Polytechnic, London, S.E.1—The Principal. A head of the Mining Department at the County Technical College, Mansfield—The Principal. A lecturer in biology and some mathematics at the Stockwell Training College, London, S.W.9—The Principal. External examiners in scientific, medical and other subjects for various degree examinations in the University of London—The External Registrar, University of London, South Kensington, S.W.7 (July 3).

ERRATUM.—In NATURE of May 27, p. 764, twelve lines from foot of first column, for "*nn* higher unstable and lower grades" read "unstable *nn* higher and lower grades".

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Fibres from the Coat of a Blackface Lamb

IN the course of the study of the lamb's coat of various breeds of sheep, a range of fibre forms has been recognised by Duerden and Dry. In this method of classification, the apparent thickness of the fibres is of great significance; but analogous to results obtained from work on crimp, it is now suggested that it may not be entirely ascribed to increase of cross-sectional area, but may be due to a twist of the fibre. Thus a thick or thin filament would appear according as the major or minor axis of the cross-sectional ellipse was seen. Prof. Duerden kindly supplied typical prototrichs from the fleece of a Blackface lamb aged 1 month.

The specimens examined were taken as being characteristic of the extreme types of fibres of the Duerden range. The fibre was observed at magnification 500 at marked points along its length and oriented at each point through 180°. The fibre thickness, the ellipticity and the circumference so measured, together with axial orientation, were plotted against distance along the fibre for each case examined.

Type (a), or sickle tipped fibre : Visually the fibre may appear as being composed of three parts along its length : (*A*) the sickle-shaped tip, (*B*) a finer portion of the stem, and (*C*) a thick portion which is a definitive fibre or fibre proper.

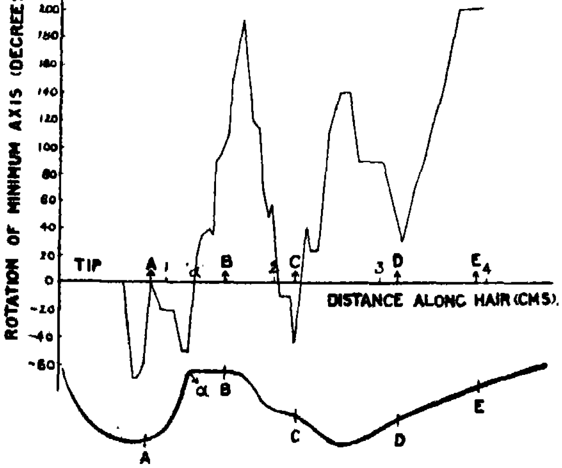

FIG. 1.

Measurement of cross-sectional area shows that the decrease in thickness from the tip to the next proximate portion of the fibre, if any, is of very small significance. Following this, the cross-sectional area of part (*C*), namely, the fibre proper, may be such that the final value is seven or eight times that at the sickle tip. Measurements of the angle or orientation of the minor axis of cross-section of a typical sickle tip fibre, kindly supplied by Duerden, are shown in Fig. 1, the diagram of the fibre below indicating the portion and visual appearance of the fibre examined. The angle of orientation follows the natural crimp of the fibre almost exactly.

Additional attention was paid to the point of inflection of this fibre, designated by α, namely, the point at which apparently the sharp transition takes place from the thick sickle tip to the thinner filament, and where a sharply defined bend occurs in the fibre form. The two photomicrographs, Fig. 2, were taken at the point α in two directions at right angles to each other; coincident points, *a*, *b*, *c*, *d*, *e* and *f* are marked on each picture. A comparison of the two pictures shows clearly what has happened. A thick place when viewed in one plane becomes a thin place when viewed at right angles and vice versa. The value of the circumference along this portion shows an almost constant value.

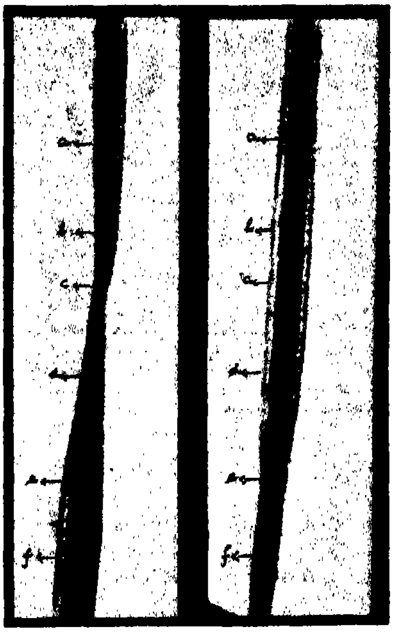

FIG. 2.

The point α is therefore in reality a place of concentrated twist, that is, there is not a sudden decrease of thickness at this point, but a sharp rotation of the axes of the cross-sectional ellipse about the axis of the fibre length. The later increase in thickness at part (*C*) is real, and not due to rotation.

Type (b), sickle tip not evident : Samples provided by Prof. Duerden were longer in length than the sickle tip fibres, taken from the same animal ; they were about 6·5 cm. long as against 4·5 cm. In these fibres the thickness shows no sudden changes, but a gradual increase along the whole length of the fibre. The ellipticity, in contrast to that of the sickle tip fibres, initially increases (not decreases) in value, and then settles down to oscillate about an average. In sickle tip fibres the ellipticity is high distally and decreases rapidly proximally. The orientation of the axes again closely follows the natural crimp. It would seem that in the sickle tip fibres, type (*a*), the end portion shows an apparent thickening, due to visual presentation of the major axis to the eye, whilst lower down the fibre the apparent attenuation is a consequence of viewing the minor axis. The same point on such a fibre viewed in a plane at right angles to the first, shows a reversal of these dimensions.

In consequence of these observations, classification of fibres according to their apparent tip thickness becomes a matter for careful consideration as to whether such variations are real, or are associated with fibre twist of a concentrated character at a particular point, or due to both twist and variation of ellipticity of the cross-sectional contour.

Miss A. L. Walker carried out most efficiently the measurements recorded.

S. G. BARKER
(Director of Research).

Wool Industries Research Association,
Torridon, Headingley,
Leeds, 6.

NATURE, 130, 736, Nov. 12, 1932.

Presence of Formaldehyde in Dew

LAST year we reported the presence of formaldehyde in rain-water[1]. We have observed that the amount of formaldehyde in freshly collected rain-water varies from 0·00015 to 0·001 gm. per litre.

Recently we analysed ten samples of dew collected at Allahabad, which is a comparatively dry place. The amount of dew collected was small and was about 10 c.c. in each case. In every sample of dew collected so far, formaldehyde could be detected at once by Schryver's test. On carrying out comparative experiments, we could estimate approximately the amount of formaldehyde present in dew. The amount of formaldehyde in dew is appreciably greater than that present in rain water. In most of the samples of the dew analysed the amount was approximately 0·0015 gm. per litre.

It appears that formaldehyde in dew comes from air in contact with grass, leaves, soil, etc. It is well known that almost all organic substances in the wet condition when exposed to light and air form formaldehyde. The origin of this formaldehyde has not yet been satisfactorily explained. We are of the opinion that organic substances, which are rich in energy, when exposed to light and air, are oxidised by atmospheric oxygen to carbon dioxide and water. The freshly-formed carbon dioxide appears also to be rich in energy, and with water can undergo photosynthesis to formaldehyde in presence of light more readily than ordinary carbon dioxide present in the atmosphere. That is why formaldehyde is more easily detected in the photo-oxidation of organic substances, which give out energy in their oxidation, than in the case where ordinary carbonic acid or bicarbonate solutions are exposed to light. In some cases, however, such as the photo-oxidation of glycine, formaldehyde, apart from photosynthesis, may also be obtained as a direct product of its photo-oxidation; but in the majority of cases in the photo-oxidation of organic substances, formaldehyde is likely to be produced from the photosynthesis of the energy-rich carbon dioxide and water which are products of photo-oxidation in presence of sunlight. The formaldehyde produced in this way will be present in the air which comes in contact with organic matter present on the surface of the soil, wet leaves, grass, etc.

N. R. DHAR.
ATMA RAM.

Chemical Laboratory,
University of Allahabad,
Allahabad, India.

[1] NATURE, 130, 313, Aug. 27, 1932.

Constitution of Dehydro-Ascorbic Acid

SOME time ago[1] we found that by the action of a copper acetate solution upon ascorbic acid, a dehydro-ascorbic acid is formed, which has the formula $C_6H_6O_6$, that is, it has two hydrogen atoms less than ascorbic acid. The determination of the free hydroxyl groups according to Zerewitinoff, shows for the dehydro-acid only two hydroxyls, in contrast to the original acid which gives four. One of the two hydroxyls removed by oxidation is the enolic hydroxyl, which is responsible for the reducing power of ascorbic acid.[1]

The dehydro-ascorbic acid is most likely an inner peroxide; which would account for its oxidative qualities.

According to Micheel and Kraft[2], oxidation of ascorbic acid to dehydro-ascorbic acid should lead to the formation of a new hydroxyl group. This is erroneous.

P. KARRER.
H. SALOMON.
K. SCHÖPP.

Chemical Institute,
University, Zurich.
April 26.

[1] P. Karrer, H. Salomon, K. Schöpp, R. Morf, *Acta Helv.*, **16**, 181; 1933. Vierteljahresschr. *Züricher Naturforsch. Ges.*, **78**, 9; 1933.

[2] Micheel and Kraft, *Z. physiol Chem.*, **215**, 215; 1933; and NATURE, **131**, 274, Feb. 25, 1933. Compare also P. Karrer, G. Schwarzenbach und Schöpp, *Acta Helv.*, **16**, 304; 1933.

Rôle of the Solvent in Electrolytic Dissociation

IN a letter to NATURE of April 22, Dr. A. R. Martin has discussed the interpretation to be placed on the experiments of Hughes and Hartley[1] on the effect of small additions of water on the electrical conductivities of salts in methyl alcohol and acetone.

We have recently completed a series of determinations of the conductivities of lithium chloride in water – ethyl alcohol mixtures extending from pure water to pure alcohol, and the results have some bearing on this question. We find that the electrical conductivity at infinite dilution varies very nearly inversely with the viscosity of the solvent, that is, $\Lambda_0\eta$ is constant, in solvents containing up to about 20 mol. per cent alcohol. As the proportion of alcohol is increased, $\Lambda_0\eta$ then decreases continuously to its value in pure alcohol. This adds further support to the view, previously based on measurements of the partial vapour pressures[2], and of the molar volumes and molar refractivities[3] of lithium chloride in these solvents, that, until more than about 20 mol. per cent of alcohol is present, the ions remain solvated almost entirely by water, but as the proportion of alcohol is further increased, alcohol molecules enter the 'solvation sheath' of the ions to a steadily increasing extent. In the case of potassium iodide, $\Lambda_0\eta$ increases appreciably with the first additions of water, but it afterwards decreases and for the greater part of the concentration range the curve follows the same course as that of lithium chloride.

In connexion with Dr. Martin's remark that the extent of dissociation is determined by the free energies of the ions and undissociated molecules in the solvent, and that the solvation of an undissociated molecule may be a factor comparable with the solvation of an ion in these quantities, an extreme case, recently investigated by Hamilton and Butler, is of some interest[4]. It was found that zinc chloride, although a typical strong electrolyte in water and practically a non-electrolyte in alcohol, has nearly the same free energy in the two solvents. The consequences of this are interesting.

Let $(H_M)_W$, $(H_I)_W$ be the solvation energies of the undissociated molecules, and of the ions in water, and I the ionisation energy in the gaseous state. Then if F_W is the energy of ionisation in water, it is evident from the accompanying scheme that $F_W = (H_M)_W - (H_I)_W + I$. Similarly for another solvent A we have $F_A = (H_M)_A - (H_I)_A + I$.

$$\begin{tikzcd}
ZnCl_2 \arrow[r, dashed, "I"] & Zn^{++} + 2Cl^{-} & \text{In the gas.} \\
ZnCl_2 \arrow[u, "(H_M)_W"'] \arrow[r, dashed, "F_W"] & Zn^{++} + 2Cl^{-} \arrow[u, "(H_I)_W"'] & \text{In water.}
\end{tikzcd}$$

If the salt is largely dissociated in W and practically undissociated in A, F_W must be large and negative and F_A large and positive. Since the free energy of the ionised salt in W is about the same as that of the unionised salt in A, we also have $(H_M)_W = (H_I)_A - I$. These two requirements are only satisfied if

$$(H_I)_W > (H_I)_A, \; (H_M)_A > (H_M)_W,$$

that is, the solvation energy of the ions must be greater in W than in A, while the solvation energy of the undissociated molecules must be greater in A than in W.

Can such a state of affairs arise from the action of the dipole forces, or is it necessary to invoke some chemical interaction between the undissociated molecules and the solvent A?

J. A. V. BUTLER.
L. C. CONNELL.

University, Edinburgh.
April 26.

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[1] *Phil. Mag.*, **15**, 610; 1933.
[2] Shaw and Butler, *Proc. Roy. Soc.*, A, **129**, 519; 1930.
[3] Butler and Lees, *ibid.*, A, **131**, 382; 1931.
[4] *Ibid.*, A, **138**, 450; 1932.

Priestley as a Practical Chemist

NOT enough attention has been paid, in studying the work of Priestley in chemistry, to his admission that he was "not a practical chemist". He made that admission again and again—and amplified it—in scientific memoirs, in the memoirs of his life and in letters. The following list of references to the point should be of use to those who study Priestley: (1) "Philosophical Empiricism", etc., 1775, pp. 24, 26; (2) "Experiments and Observations", etc., 1775, p. I (reproduced in "Experiments and Observations", etc., 1790, 2, p. 295); (3) "Experiments and Observations", etc., 1779, p. 134 (*cf.* "The Collected Papers of Carl Wilhelm Scheele", trans. by Dobbin, p. 302); (4) Bolton, "Correspondence of Priestley", p. 124 (a letter, dated 12.1.1792, sent to Keir); (5) Thorpe, "Humphry Davy, Poet and Philosopher", p. 39 (a letter, dated 31.10.1801, sent to Davy); (6) "Memoirs of Dr. Joseph Priestley written by himself", Centenary edition, 1904, p. 40, par. 101. I suppose that other references to the same point are to be found.

What I call an admission, Prof. Patterson takes to mean that Priestley was not "a person who made his living by the preparation and selling of chemical compounds—a professional chemist" (NATURE, May 13).

Priestley said, writing to Davy: "As old as an experimenter as I am, I was near forty before I made any experiments on the subject of Air, and then without, in a manner, any previous knowledge of chemistry. This I picked up as I could, and as I found occasion for it from books." He said in his "Memoirs": "if I had been previously accustomed to the usual chemical processes, I should not have so easily thought of any other; and without new modes of operation I should hardly have discovered anything materially new". In the "Philosophical Empiricism" he reports that he made the acquaintance of Dr. Bryan Higgins: "I told him that, not being a practical chemist, having never had a proper laboratory, or seen much of the usual processes, I wished to have an opportunity of observing some of them: but that I more especially was in want of *chemical articles*, such as I could not easily procure at the shops."

There should be no difficulty in seeing what was meant. Priestley had a poor knowledge of chemistry—the orthodox thing—that was concerned with solids and liquids: the gases were beyond its pale. He could pursue the study of gases with the minimum of reference to the orthodox chemistry: what he needed of it he picked up as he went along. He made numerous acknowledgments of assistance that he got from friends, in learning the ordinary processes of a chemical laboratory. A certain instance is instructive. He commenced work in chemistry—upon gases, that is—in the year 1767. From nitric acid he obtained nitric oxide in the year 1772 and oxygen in March 1775. He learnt how to prepare nitric acid, with the guidance of Mr. Winch, jun., at the end of the year 1775 ("Experiments and Observations", etc., 1777, pp. 234–7).

A. N. MELDRUM.

92 Craiglea Drive, Edinburgh.
May 15.

Some Effects observed in Mice under Continued Treatment with Œstrin

DURING a recent inquiry at this Institute into the comparative effects of œstrogenic and carcinogenic substances on mice, some observations were made which suggest that œstrin brought about hernia in some of the animals.

The keto-hydroxy-œstrin employed in this experiment (for which we are indebted to the generosity of Dr. Girard) was made from the urine of pregnant mares and had a specific rotation $[\alpha]_D = +178°$. When injected into rats by the method described by Allan, Dickens and Dodds[1] it was found that 0·4 gamma gave a response in 50 per cent of ovariectomised rats. This corresponds to the figure usually given for the standardisation of crystalline keto-hydroxy-œstrin when employing the method described in that paper on a certain strain of rats.

Eight male mice were treated with subcutaneous dosage of œstrin in the right groin. During ten weeks five injections were given, each consisting of 0·5 c.c. of a 0·3 per cent solution of keto-hydroxy-œstrin in olive oil. At the end of this time, five of the eight mice were found to have bilateral scrotal hernias, their scrotal sacs being distended by viscera which normally are retained within the abdomen.

During the same period 28 male mice received applications twice weekly of a solution (0·3 per cent in benzene) of the same œstrin to the non-epilated skin of the interscapular region by means of a small paint brush. After ten weeks of this treatment, three of these mice had scrotal hernias, bilateral in one and unilateral in the other two. Examination of 90 untreated stock mice and 276 mice under treatment of various kinds not entailing the use of œstrin did not reveal a single scrotal hernia.

The same solution of œstrin in benzene applied twice a week in a similar way and for the same period to the non-epilated skin of 10 female mice not only kept them in œstrus, as tested by the ordinary smear method, but also led in some instances to an accumulation in the vagina of a mass of keratinised epithelium sufficiently large to distend the canal and to block the outlet from the uterus, both horns of which were distended considerably with fluid. These results indicate that keto-hydroxyœstrin in such a medium is readily taken up through the healthy skin, although it is impossible to ignore the possibility that some may have been taken up by the alimentary canal through the mice licking one another.

The hernias in the male mice treated with superficial applications of œstrin, and those in the mice treated by subcutaneous injection, may be reasonably attributed, it seems, to the action of œstrin. The phenomenon may have some connexion, perhaps, with the well-known fact that in certain species the pelvic ligaments are softened during pregnancy, when large quantities of œstrin are circulating in the body.

HAROLD BURROWS.
E. C. DODDS.
N. M. KENNAWAY.

The Research Institute,
The Cancer Hospital (Free),
London, S.W.3.
Courtauld Institute of Biochemistry,
Middlesex Hospital,
London, W.1.
May 23.

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[1] *J. Physiol.*, **68**; 1930.

Occurrence of Ovulation without 'Heat' in the Ewe

A RECENT study of reproductive phenomena in the ewe has shown that, in this animal, ovulation occurs regularly during the month previous to the commencement of the breeding season, and occasionally during the breeding season, without the exhibition of mating. The premises for this conclusion may be stated briefly as follows:—

(1) Four out of five ewes killed before their breeding seasons had commenced showed healthy corpora lutea in their ovaries.

(2) In seventeen ewes kept constantly with a vasectomised ram, the vaginal secretions underwent one or more cycles of œstrous changes before the first 'heat' period had occurred. These cycles possessed the periodicity characteristic of the normal œstrous cycle.

(3) Five of these ewes killed during the breeding season showed, in their ovaries, either one or two more 'generations' of corpora lutea than could be accounted for by the number of full œstrous periods through which they had passed.

(4) The diœstrous interval is sometimes twice, and rarely three or four times its normal length. It is thought that multiplication of the cycle interval takes place as a result of the occurrence of ovulation and the development of corpora lutea although œstrus does not occur.

There is evidence to suggest that under highly favourable nutritive conditions, such as are constituted by the farming practice of 'flushing', these spurious ovulation periods may be converted into normal œstrous periods at which the mating instinct is exhibited.

Cole and Miller[1] have found that a single injection during anœstrus of serum from pregnant mares containing 50 'rat-units' or more of gonad-stimulating substance, causes ovulation although 'heat' does not ensue.

Observations made by Mr. Wm. C. Miller (unpublished) have shown that the ovaries of red deer hinds killed during early pregnancy commonly contain not only the corpora lutea of pregnancy but also one or more 'generations' of atrophic corpora. Since it is probable that in the wild state very few hinds fail to conceive at the first service, this fact suggests that the phenomenon of ovulation in the absence of mating may not be confined to the ewe.

Full details of the investigation will be published shortly.

R. GRANT.

Institute of Animal Genetics,
University of Edinburgh.
May 23.

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[1] H. H. Cole and R. F. Miller, *Amer. J. Physiol.*, **104**, 165; 1933.

The Minor Details of the Planet Mars

IN the issue of NATURE for April 8, p. 518, a note appears on an article on Mars by Mr. H. B. Brydon, in which particular reference is made to my recent volume on the planet and my conclusions as to the illusory nature of the so-called canals. In order that readers of NATURE should not be misled by the article, I hasten to reply to Mr. Brydon's statements.

It is at Flagstaff that the planets Mercury, Venus, Jupiter and Saturn, as well as the Jovian satellites, have been seen covered with linear markings, which were afterwards pronounced unreal by their most prolific discoverer[1]. It is further imprudent for a believer in linear canals on the planet Mars to mention the name of Prof. G. W. Ritchey, since that great astronomer repeatedly asserted to me that, having carefully scrutinised Mars with the fine 60-inch reflector of Mount Wilson, constructed by himself, he never saw a single straight line, or canal, on the planet, though details were observed beyond the range of the most powerful refractors in existence.

My late-lamented mentor and friend, E. W. Maunder, remarked in 1894 that the so-called canals of Mars often disobey the laws of perspective; and I have demonstrated in my book the veracity of this statement, by showing that canals considered to run along arcs of great circles appear straight, not only at the centre of the disc, but also at 30° and more from the centre—a fact which, of course, establishes their illusive character.

I have also shown that the canals, after defying perspective, further defy diffraction, since they vanish in a large telescope, whereas a real, dark, planetary line, such as Cassini's division of Saturn's ring, becomes naturally darker and broader with an increase of aperture.

Lastly, I pointed out in 1909 that, in the 33-inch refractor I was using, no straight lines could be detected on Mars, while delicate detail, far beyond the reach of the small telescopes with which the illusory canals had been discovered, was held quite steadily under fine seeing.

Such objections, whether considered severally or collectively, are, of course, fatal to the alleged reality of the linear markings. The planet is far too distant, from 35 to 250 millions of miles, to show canals. The truth is that a tired eye is liable to glimpse straight dark lines on the so-called continental regions of that neighbour world when viewed through an ordinary telescope; but these optical illusions vanish in a powerful instrument, which reveals broad, complex, dusky streaks, forming no network on the planet. The surface features of Mars are thus shown to be infinitely irregular and natural, like those of all the other bodies of the solar system.

Paris. E. M. ANTONIADI.
April 25.

[1] "Illusions of Vision and the Canals of Mars", in *Popular Science Monthly*, vol. 70, May, 1907.

Electron Diffraction by Vapours

DURING the last two years, a practical method has been evolved for obtaining good photographs of the diffraction of 30–55 kv. electrons by vapours. I now get satisfactory results with any substance the vapour pressure of which exceeds 10 cm. of mercury at 750° C. With the aid of the apparatus now set up, measurements of the electron diffraction of any known stable organic compounds can be made, and the investigation of many interesting structural problems arising in inorganic chemistry is also rendered feasible. A number of preliminary photographs have been taken of members of the following series and of certain other substances: Polyhalogen derivatives of methane and ethane; aromatic hydrocarbons and some of their isomeric dihalogen compounds; polymethylene dibromides from butane and decane; and volatile halides of the elements and of cyanogen.

It has recently been found that nearly double the number of diffraction rings that have been observed up to now can be registered by using a variety of photographic emulsions. Hence most of the work must be repeated before the full results can be published in detail.

HENRY DE LASZLO.

The Sir William Ramsay Laboratories of
Inorganic and Physical Chemistry,
University College, London, W.C.1.
May 23.

Viscous Damping of Vibrating Metal Bars

WITH the exception of those made by K. Honda and S. Konno[1] and also those by K. Iokibe and S. Sakai[2], few measurements of viscous damping in metals have been made. I have made some experiments concerning this problem with the assistance of Mr. K. Kubo[3]. The metals experimented with were aluminium, duralumin, copper and brass, each in the form of a bar clamped at one end and free at the other. To analyse the result the appropriate solutions of the following equation were used:

$$\rho\frac{\delta^2 y}{\delta t^2} + Ek^2\frac{\delta^4 y}{\delta x^4} + \xi k^2\frac{\delta^5 y}{\delta t\,\delta x^4} + \zeta\frac{\delta y}{\delta t} = 0,$$

where E is Young's modulus, ξ the coefficient of solid viscosity, ζ the coefficient of air damping, k the radius of gyration of a cross section of the bar, and y the deflection of the bar at x.

Vibration experiments were made in a vacuum chamber of inner diameter 40 cm., inner height 24 cm., and thickness 1 cm. A circular hole of 3 cm. diameter in the vertical wall of the chamber was plugged with a disc having parallel plane surfaces, through which the movement of the test piece in the chamber was observed. The air in the chamber was pumped out through a pipe system connected to a Cenco Megavac pump and a glass Langmuir diffusion pump, by which the pressure was lowered to 1/2,000 mm. of mercury. Special arrangements for the clamping and the motion of the bar as well as the photographic recording were devised.

The results, after analysis, showed that the coefficient of solid viscosity ξ in C.G.S. units is $7{\cdot}5 \times 10^6 \sim 8{\cdot}0 \times 10^6$ for duralumin, $5{\cdot}9 \times 10^6 \sim 6{\cdot}8 \times 10^6$ for aluminium, $9{\cdot}3 \times 10^6 \sim 11{\cdot}6 \times 10^6$ for copper, and $12{\cdot}7 \times 10^6 \sim 15{\cdot}0 \times 10^6$ for brass. It was also found that the coefficient of solid viscosity is different for different amplitudes of vibration. For large amplitudes the coefficient was also large.

From this work it will be seen that the values of the solid viscosities of metals are so small as to be of the order of $10^6 \sim 10^7$ in C.G.S. units. If the energy of vibration is dissipated outwards from the clamped end, the value will be apparently increased to a much greater degree. In an aeroplane flying in air or in analogous cases, little energy can be dissipated outwards, while the inner damping is too small, so that it is probable that the phenomena of perfect resonance will frequently take place. In the case of a building or of a machine on land, the dissipation of vibrational energy is not the effect of the viscous or other frictional damping but is chiefly due to the radiation of the energy from the boundary, so that the synchronous vibration in that case does not play an important part in the nature of the building or machine. The explanation of the increase of damping with the increase of the amplitudes of vibration is somewhat difficult in the present state of our knowledge on mechanics.

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April 24.

[1] *Phil Mag.*, 42, 115–123; 1921.
[2] *Phil. Mag.*, 42, 397–418; 1921.
[3] *Rep. Aeron. Res. Inst.*, Tokyo, No. 89; 1932.

Supersonic Vibrations set up in a Zinc Bar undergoing Transverse Vibrations

IN the course of experiments on the latent splitting of bars as reported by one of us[1], we noticed a very curious and interesting phenomenon in zinc.

When the zinc bar after observations of frequency had been removed, we noticed on examining it that besides rupture lines, a large number of indentations and protuberances were clearly visible at very regular intervals along one of the vertical sides of the bar. It had the familiar appearance of the

FIG. 1.

Kundt's tube phenomenon, where nodes and antinodes are formed by the stationary longitudinal vibrations of the enclosed gas. The protuberances were shining spots formed by the bulging out of the zinc locally. The effect was photographed and is reproduced in Fig. 1 after enlargement. The distances between the successive nodes were measured directly on the zinc bar by means of a microscope.

As the reproduction shows, these nodes and antinodes are at extraordinarily regular intervals. The mean value of the distance between consecutive nodes came out to be 0·141 cm.

Now the velocity of longitudinal waves or the velocity of sound in a material is given by

$$V = \sqrt{E/\rho}$$

where E is Young's modulus and ρ the density of the material. But the velocity V of the longitudinal waves is also given by

$$V = n\lambda$$

$$\text{Therefore, } n^2\lambda^2 = E/\rho$$

Substituting the values of E and ρ for zinc and of λ as found from actual measurement, we get the value for frequency

$$\begin{aligned} n &= \sqrt{\frac{8{\cdot}7 \times 10^{11}}{7{\cdot}1 \times (0{\cdot}282)^2}} \\ &= 1{\cdot}24 \times 10^6 \end{aligned}$$

This high frequency, of the order of a million, is probably due to the impact of zinc crystals in the bar during the course of alternate compression and extension in the act of vibration.

The frequency of transverse vibration of the zinc bar had been varied from nearly 78 to about 27 and the appearance reproduced in Fig. 1 was formed during the course of this variation. The thickness of the bar was 0·066 cm.

We made a few attempts to reproduce the phenomenon noted here, but have not been successful so far. It is possible that there is a critical frequency of the transverse vibration of a given bar for which the longitudinal vibration excited is the strongest, depending on the size of the metal crystals contained in the bar. It may be noted here that it is well known that metallic zinc contains ordinarily well-developed crystals.

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April 3.

[1] NATURE, 127, 90, Jan. 17, 1931.

Characteristics of the Ionosphere

IN the course of recent experiments[1] on the structure of the ionosphere, we have found that not two only but several[2] 'layers' exist in which there is either a maximum, or a tendency towards a maximum, of ionic density. Since any complete theory of the structure of the upper atmosphere or of the transmission of radio waves through it must take these facts into account, it is thought that a brief summary of the results will be of interest. Certain observations concerning abrupt variations of ionisation will also be described. In all these experiments transmission was at normal incidence to the layers.

(1) It has been found that in addition to the E region at a height of 100–120 km. and the F region from 190 to 300 km. there is an intermediate reflecting region, which we shall refer to as the M region. The data indicate that the average height of the M region is approximately 150 km. but that on some days it may be so high as 180 km. while on other days it may be so low as 130 km. The M region has been found on a number of occasions before noon during December of last year and January and February of this year. The data usually indicate that when this region is found there is a well-defined maximum of ionic density and that it is separated from the E and F regions by ionisation minima.

In order to observe the M region, it is necessary that the frequency used be great enough to permit penetration of the E region, but small enough to give reflection from the M region. The M region can, therefore, be observed only so long as its maximum of ionic density exceeds that of the E region below it.

As the maximum ionic densities of the E and M regions have been found to be of the same order of magnitude during the times when they are both observed, and as the maxima do not vary at the same rate with time, it is reasonable to assume that the M region maximum is normally present but that it is shielded by the E region except for a few hours in the middle of the day.

(2) The ionisation in the F region does not increase uniformly with height but has often been found to have a step-like structure[3]. This indicates that there is a tendency for the formation of several ionisation maxima in the F region. Occasionally two maxima have actually been found, but ordinarily these subregions overlap and the ionisation increases in a series of 'steps'. At times the 'treads' of this step-like structure are strikingly level, indicating remarkably abrupt ionic density gradients at heights near 200, 240 and 280 km. This type of phenomenon has been found only during daylight hours, and it may be said that if the steps are present at night they are very difficult to find. These facts suggest that the formation of these subregions depends upon the ionising activity of the sun.

(3) Throughout the daylight hours during the past winter the ionisation of the F region has often been found to vary in an erratic manner. The maximum ionic density exhibits abrupt changes which are often so great as 25–50 per cent within time intervals of 15–30 minutes. These changes suggest that there may be some variable source of ionisation, cosmic or solar in nature, the effect of which is superimposed upon a normally steady ionising effect due to the sun. The time of maximum ionisation seems to occur near noon, but the maximum is not at all well-defined, since the ionic density has about the same average value from 9.00 a.m. until 3.00 p.m. (winter and spring at Deal, N.J., latitude 40° N.).

(4) The ionisation of the E region increases with time in a uniform manner, attaining a maximum near noon. The abrupt changes found in the F region are not normally present in the E region.

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April 5.

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[1] The method used was that previously described in the *Proc. Inst. Radio Eng.*, July, 1932.

[2] This had previously been suspected for days of magnetic storms (*loc. cit.*, p. 1145).

[3] T. L. Eckersley also has concluded that the F region may be stratified. See *J. Inst. Elec. Eng.*, vol. 71, September, 1932.

Output of Electrical Energy by Frog-Skin

IF a piece of frog-skin, mounted with glucose Ringer solution on both sides, is connected in series through two calomel electrodes with a micro-ammeter, a current may be observed to flow through the circuit for many hours. With a piece of skin 1·6 cm.^{2} in area in a circuit of total resistance 1,500 ohms the current is 20–30 × 10^{-6} amperes during 12 hours after setting up.

Between 0° C. and 30° C. the resistance of the skin falls steadily, the potential rises to a maximum at about 20° C. and then falls off, and the current rises to a maximum at about 25° C. before decreasing. The output of electrical energy by the skin can be calculated as equivalent to the Joule heat developed in the circuit. This was found for four different skins to lie between 5 and 9 × 10^{-8} calories per minute per gram dry weight of ventral skin at 20° C. It has been shown[1,2,3] that when the *ionic composition* of the solution is constant the frog-skin potential is maintained by oxidation processes. It is of interest, therefore, to see what fraction of the energy released by oxidation may appear as electrical energy. The respiratory quotient of the skin of *Rana temporaria* is 0·97[4]. The average oxygen consumption of frog-skin[3] was found to be 20 × 10^{-3} c.c. oxygen per minute per gram dry weight at 20° C. (other values are summarised by Adolph[5]). Assuming that molecules of $(C_6H_{12}O_6)_n$ are burnt and taking the heat of combustion per gram as 680,000 calories, it will be found that the energy released by oxidation processes is on the average 100 × 10^{-8} calories per minute per gram dry weight at 20° C. The electrical energy output calculated above is 5–10 per cent of this value.

The temperature coefficient of the electrical energy output for a rise of 10° C. was determined for three skins and compared with the average Q_{10} for respiration for four skins.

	Q_{10} Electrical Energy			Q_{10} Energy from Combustion.
0° C.-10° C.	2·85	1·99	3·90	3·6
10° C.-20° C.	1·4	1·44	1·41	2·0
20° C.-30° C.	—	—	—	1·9

The power output is a maximum at 24° C. for the electrical process and at 38° C. for the respiratory processes of the skin. Lund and Moorman[6] have found that values of Q_{10} for potential and oxygen consumption of the skin of *R. pipiens* between 16·4° C. and 26·4° C. are 2·14 and 2·01 respectively. (In my work Q_{10} for the potential in this interval is near unity.) They adduce this approximate equality in support of a theory of the skin potential based on "the flux equilibrium of the oxidation-reduction systems" in the cells of the skin. Since, however, the frog-skin does not behave as a reversible galvanic cell, the potential cannot be related directly to the energy released by oxygen consumption except on the lines indicated above.

There are also objections to the interpretation of the skin potential, which is measured between reversible calomel electrodes, in terms of oxidation-reduction potentials which can only be measured with the aid of an inert metal electrode to act as an electron donor or acceptor[8]. The skin potential, like the injury potential of crab's nerve[7], depends on oxygen consumption and also on the nature and concentration of the electrolytes present[8]. With these two factors in mind, further work is in progress in conjunction with Dr. R. J. Pumphrey, on the nature of the frog-skin potential.

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April 14.

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[1] Lund, *J. Exp. Zool.*, **51**, 265, 291, 327; 1928.
[2] Francis and Pumphrey, *J. Exp. Biol.* In press.
[3] Francis, *J. Exp. Biol.* In press.
[4] Bornstein and Klee, *Arch. exp. Zellforsch.*, **3**, 395; 1927.
[5] Adolph, *J. Exp. Zool.*, **53**, 313; 1929.
[6] Lund and Moorman, *J. Exp. Zool.*, **60**, 249; 1931.
[7] Hill, NATURE, **131**, 501; 1933.
[8] Uhlenbruck, *Z. Biol.*, **82**, 225; 1924.

The Astronomical Radiative Stability

ASTRONOMERS are doubtless not unaware of the enormous radiative uniformity that is demanded by the permanence of organic life on the earth. If the temperature at the earth's surface were altered even for a single season from its actual value about, say, 27° C. or 300° K., by 50° in excess or defect, all terrestrial organic life would be blotted out never to return. This would happen if even only once in the hundred million years demanded for terrestrial organic evolution the effective temperature of the solar radiating surface changed from the present mean value 6,000° K. by 1,000° in excess or defect, if it were a matter of steady state, while during the time of this change the stream of radiation incident on the earth would be altered in a proportion much greater. On current theories the difference between the top and bottom of the radiating solar atmosphere would be great in comparison with this figure, and lower down vast temperatures are soon reached. This shows how extremely steady the balance must be, and how slight the solar evolution must have been even in that vast time. As one result, the sunspot disturbances, even though they occupy only a very small part of the area of the solar disc, would have to be purely superficial phenomena. The output of radiation is very steady, as from a steady interior; yet the heavens are full of variable stars. Perhaps these considerations were remotely in view when long ago Whewell and Brewster were discussing the plurality of worlds, and Huxley championed the geologists against Kelvin.

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May 14.

The Combustion Problem of Internal Ballistics

IN a recent paper on the combustion problem of internal ballistics[1], we have attributed jointly to Love and Pidduck[2] a statement as to the importance of including both temperature and pressure in the rate of burning law for colloidal propellants. Their paper was published in two parts, and the statement in question was made in Part 2, which was entirely the work of Dr. Pidduck. Our reference, in consequence, was misleading, and we desire to correct the error.

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May 23.

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[1] *Phil. Mag.*, 7, **15**, 529; 1933.
[2] *Phil. Trans.*, A, **222**, 599; 1922.

Research Items

Dragons. In *Man* for May, Mr. G. D. Hornblower discusses the origin and distribution of the art-forms of the dragon. The conception of a blend of various forms of fierce and dangerous animals such as lion, eagle and snake appears in the earliest pictorial records of the Near East. In Mesopotamia its association with deities may attribute to them the qualities associated with each animal. Dragons are both evil, as Tiâmat, or beneficent, as in the wings (a dragon survival) of the sun disc in Egypt. On all the earliest cylinders animal forms predominate, much subject to distortion. Animal art disappears in Mesopotamia under Semitic influence, but reappears in Assyrian art, while it holds its position in Egypt and North Syria. Beyond Assyria in Urartu (Armenia), dragons, lions and aurochs pointing to Assyrian influence appear on the objects looted by Sargon II from Musasir. It has been shown that Mitanni-Khattite art extended to this region, and thence to the Medes and through them to the Achaemenids, this zone including the hilly country around Elam, the modern Luristan, whence come objects of art attributed to the Kassites of the Iron Age and to be related, through Armenia, to a northern or 'Scythian' region of this art-province. Nomad peoples gave to this animal art a new life and vigour. The Scythians compounded an ancient animal art, possibly descended from an ancient stone age art extending from Finland to Siberia, with the influences from Mesopotamia and formed the animal art called 'Scythian', later adopted and further modified by the Sarmatians. In the southern province the animal art developed the peculiar characteristic of the elongation convention. Scythian elements were introduced into China in the Ts'in and Han dynasties, when the Chinese began to ride horses and changed their military equipment. In this new phase of Chinese art two provinces are to be discerned, one in which the chief characteristic is a plain animal form rendered naturalistically, and a second in which objects are decorated in foreign style, but with a well-developed Chinese manner.

Tell-Billa. An account of the joint excavations of the University Museum, Philadelphia, and the American Schools of Oriental Research at Tell-Billa, which is to appear in the *Museums Journal*, Philadelphia, opens with a report on the pottery by Dr. E. A. Speiser in vol. 23, No. 3. Tell-Billa is a mound fifteen miles north of Mosul, the excavation of which began in 1930 after a preliminary reconnaissance in 1927. This had indicated the importance of this mound and the adjacent Tepe Gawra, eight miles away, for knowledge of pre-Assyrian civilisation north of Nineveh. The two sites in conjunction have furnished stratified evidence for the study of more than four millennia of north Mesopotamian history, extending from neolithic down to the Hellenistic period. Gawra is by far the older site, the occupation of Billa beginning only when 14 metres of occupation deposits had covered the site of Gawra. From about 3000 B.C. to the middle of the second millennium, the two mounds show a parallel course of development. By this time Gawra had become unsuitable for further occupation and was abandoned for Billa. The occupation levels at Billa have been followed down to virgin soil. These show seven main strata, which afford a series of pottery sequences demonstrating ceramic changes and development at Billa and also contact with the outside world. From the survey of strata 7 and 6 (the lowest), it is apparent that the differences between the two strata are chronological rather than cultural. The chalice, first painted, then incised, is the most characteristic ware of strata 7 and 6 and is found in the seventh stratum of Gawra and at Nineveh. In south Mesopotamia a painted fragment occurs at Fara, of which the earliest level falls within the Jemdet Nasr period preceding the early dynasties of Ur. The Jemdet Nasr fabrics also include the squat pot with sharply marked shoulder which is well established at Billa. The distribution of the chalice corresponds roughly with the Highland Zone and has been traced from Anatolia to Persia. It is evident from the relation of Billa and Gawra that the chalice folk were intrusive. From this time onward Billa was subject to a succession of invasions from the north and north-east, with an influx of cultural influence from the south in stratum 5.

Norwegian Oyster Pools. Important hydrographical and biochemical work in connexion with oysters is described in Bergens Museums Årbok, 1932. 1. Hefte ("Naturvidenskabelig Untersuchungen in Norwegischen Austern-Pollen", von Torbjørn Gaarder und R. Spärck). Two oyster pools were investigated, the Espevik-Poll and the Saelø-Poll, both connected with the Hardanger Fjord. The chief conclusions are that the meteorological conditions, especially light, have a dominant influence on the physico-chemical relations and consequently on the life in these pools, since the light regulates the assimilation efficiency of the phyto-plankton which is the food of the oyster. The brackish water layer on the surface varies in thickness according to the rainfall, and the light must penetrate this layer effectually in order to reach the salt-water layer in which assimilation takes place. In a good year, the temperature below the brackish-water layer may reach a high figure and the smaller green organisms up to 3μ which are the chief food of the larvæ will abound in spring and summer. Unfortunately, the same food is taken by the small animals, especially gastropod larvæ (*Cerithium* particularly) and mussel larvæ which flourish under the same conditions. Efforts are made to get rid of these. In the bad years with little sunlight, bacteria increase greatly and it is interesting to find that this coincides with outbursts of the dinoflagellate *Ceratium*, the molluscs being little in evidence. The results of these researches indicate that much may be done with the pools in the way of oyster rearing provided that there is sufficient sunlight, the natural conditions being such that usually the chemical food required by the nannoplankton is adequately represented with the exception of nitrates and phosphates, which can be increased artificially.

Cattle Blood-Sucking habit of a Bug. On the occasion of describing a new genus and species of Anthocoridæ (Hemiptera) from New Zealand, W. E. China discusses the feeding habits of bugs belonging to this family (*Ann. and Mag. Nat. Hist.*, April, 1933). They appear to be probably all predaceous on eggs and larvæ of other insects, and even on the adults of smaller forms, such as Aphididæ and Coccidæ. Thus, *Triphleps insidiosus*, Say, and *T. australis*, China, feed on the eggs of the false cotton boll worm, *Heliothis obsoleta*; the many species of *Anthocoris* found in flowers probably prey on the thrips which live there; *Piezostellus flavipes*, Reuter, occurring in granaries, probably feeds on eggs and larvæ of grain feeding Coleoptera and Lepidoptera, or perhaps on mites, etc. Many species live under bark, and such is the case of the new one described in the paper, *Maoricoris benefactor*, which preys on the bark-beetle *Acrantus opacus*, White. An extremely interesting member of the family is *Lyctocoris campestris*, which is commonly found in stables and cattle-sheds and is known to suck the blood of horses and cattle. This exceptional habit suggests a possibility that *Lyctocoris* may act as a transmittor of foot and mouth disease. While the evidence in favour of this novel hypothesis is purely circumstantial, experimental examination would be of considerable interest.

Karyology and Systematic Relationship. A series of eight papers mainly devoted to the chromosome morphology of various economic plants is found in the recently issued *Bulletin of Applied Botany, Genetics and Plant-Breeding*, Leningrad. Vakar has made a study of the chromosomes in various interspecific wheat hybrids, which throws further light on their relationships, *T. pyramidale* being near *T. turgidum* as *T. sphærococcum* is allied to *T. vulgare*. The paper by Senyaninova-Korchagina on the chromosomes of various *Ægilops* species has a bearing on the origin of the bread wheats. The tetraploid and hexaploid species of *Ægilops* possess only one pair of tri-articulate chromosomes and one pair with 'heads'. From evidence of this kind it is concluded that these species have arisen through interspecific crossing and subsequent doubling of the chromosomes in the hybrids. There is evidence also of a phylogenetic shortening of one chromosome arm into a head. The same author has studied the chromosomes of *Vicia faba* and the related *V. nanbonensis* and *V. serratifolia*. She finds that while, for example, the races of *V. narbonensis* from Glasgow and Transjordania are morphologically alike, their chromosomes differ in the ratios of arm length. An extensive study of the Trifoleæ by Chekhov shows that nine species of *Ononis* out of ten are tetraploid, one being octoploid (64). In *Trigonella*, nine species have 16 chromosomes and one 28, probably due to an association of four chromosomes in a tetraploid. In this group most of the polyploid forms are perennial and have larger fruits. Emme has similarly investigated the species of the subgenus *Euavena* and the pentaploid hybrids of *Avena*.

Thickness of the Greenland Ice. The Wegener expedition to Greenland in 1930–31 was the first to use experimental seismic methods for measuring the thickness of the ice-sheet. Dr. E. Sorge has now given some account of these experiments and their results (*Geog. J.*, April). Measurements of the thickness were made in twelve places at 12, 42, 62, 82, 120 and 400 kilometres from the west coast respectively. The last of the series was at the station of Eismitte in the heart of Greenland at an elevation of 3,000 metres. Apparently the most accurate measurements were taken at 120 km., where observations were numerous. At Eismitte the seismograph was put up in only one place but several readings were taken. Dr. Sorge believes that at the central station the ice-sheet is about 2,000 metres thick but admits that, owing to possible error in the readings, it may be any depth between 1,800 and 2,700 metres. Even the smaller figure suggests thicker ice than was expected. At the 120 km. station the ice is 1,600–1,800 metres thick and the rock floor has slopes up to 30°. It is clear that the land surface of Greenland is not highland throughout and that much of the interior is not so high as the ranges near the coasts. In fact, the shape suggests a plate with a broader and higher eastern than western edge. Dr. Sorge discusses the methods employed and possible sources of error in the observations. One of the chief difficulties seems to be the weight of the explosives required, which is a serious problem in transport to the interior.

Earthquakes of Northern Africa. The African continent is usually regarded as one of general stability at the present time, and, if we confine ourselves to earthquakes of the first order, the impression is probably justified. There are, however, various regions in which shocks of moderate strength are common, one of the most important being that which consists of the three northern countries of Algeria, Tunis and Morocco. Mme. A. Hée has given an interesting account of the work recently done in those countries (*Matériaux pour l'Étude des Calamités*, No. 28, pp. 291–337; 1932). Regular observations in Algeria date from 1911, when two Mainka horizontal pendulums were erected in the Observatory of Alger-Bouzaréah. In Tunis, the meteorological service collected reports on earthquakes from 1922 and a Mainka pendulum was installed at Tunis in 1926. Since 1929, the Institut Scientifique Chérifien has undertaken the collection of macroseismic observations, but no recording instrument exists in Morocco. Thus, our knowledge of Algerian earthquakes is at present the most complete, and Mme. Hée gives lists of 586 earthquakes between the years 1911 and 1931, distributed in 22 different zones, four of these shocks reaching intensities 9 or 10. The more active zones, as usual, border the regions in which the sea bed slopes most steeply.

Cosmic Rays. Year Book No. 31 of the Carnegie Institution of Washington contains a summary by Prof. A. H. Compton of the results which have been obtained by the nine observers who, with the aid of a grant from the Carnegie Corporation of New York, have been sent with identical sets of apparatus to representative portions of the earth's surface. The rays are found to be influenced by the earth's magnetic field and are stronger at the magnetic poles than at the magnetic equator. The increase of intensity of the rays with altitude has been found to continue to very high elevations. The bursts of ionisation, which have been investigated show that a single cosmic ray is capable of releasing at least 10^8 electron-volts of energy. The diurnal variation of the rays at mountain stations is found to be greater than those observed previously by observers at lower levels. Argon gas under pressure is found to be a much more sensitive detector of cosmic rays than other gases. On the whole, the observations are in favour of the view that cosmic rays are streams of electrified particles such as electrons or protons. See also NATURE of May 20, p. 713.

New Observations on the Heaviside Layer. Ratcliffe and White have recently described the results of a method for recording continuously the reflection of wireless signals from the upper atmosphere (*Proc. Phys. Soc.*, May). Short wave trains are radiated by a special transmitter and the pulses with their echoes are received at a station a few kilometres away and recorded by a cathode ray oscillograph. The time base of the oscillograph is synchronised with the pulses by controlling both transmitter and oscillograph from the same A.C. mains. A record was taken from the oscillograph on continuously moving photographic paper. The records show very clearly the behaviour of the ionised layers, and from examination of a number of records, the 'normal' summertime behaviour has been deduced. During the day, reflection takes place from the E layer at an equivalent height of about 120 km. In the evening, the reflection is gradually transferred to the F layer at about 260 km. The height of this region rises gradually and the echo splits into two components which rise and disappear successively. At sunrise this sequence is reversed. The E region reflection sometimes reappears during the hours of darkness, and this abnormal behaviour seems to be connected with an ionising agency quite different from that producing the daytime E region. It is possible that this agency may be the electric fields in the neighbourhood of charged rainclouds. Appleton and Naismith describe in the same journal measurements which they have been making for some time on the maximum ionic content of the Kennelly-Heaviside layer. The density of ionisation is connected with the critical wave-length below which the rays penetrate the lowest layer and are reflected at an upper layer. Observations were made once every week at about noon. The curve shows a summer maximum of ion density. The summer maximum ionisation was greater in 1931 than in 1932, and this may be correlated with greater sunspot activity in the former year. Occasions of abnormally high ionisation density are common during the summer months, and a fairly high correlation has been found between high ionisation and thunderstorm activity.

An Optically Active Inorganic Salt. Sulphamide, $SO_2(NH_2)_2$, behaves as a weak dibasic acid and if sodium rhodichloride, Na_3RhCl_6, is added to a solution of its sodium salt, the salt $Na[(H_2O)_2Rh(N_2H_2SO_2)_2]$ is formed. Since the residue $-NH.SO_2.NH-$ occupies two of the six octahedral co-ordination positions of the rhodium atom, the other two being occupied by water molecules, the acid radical in square brackets should give the usual *cis* and *trans* forms, in the latter of which the $-N_2H_2SO_2-$ groups occupy two positions in the plane, and one position in the plane and one axis, respectively. This configuration is dissymmetric and should exist in optical isomers. Mann (*J. Chem. Soc.*, April; see also NATURE, 130, 368, Sept. 3, 1932), who has prepared this salt, has resolved it into optical isomers by crystallisation with dextro and lævo α-phenylethylamine and with d-nor-ψ-ephedrine. The occurrence of molecular dissymmetry among purely inorganic compounds is very rare, since it is almost invariably dependent on the presence of suitably co-ordinated ring systems and these are difficult to form with entirely inorganic elements, or are insoluble. The new compound, therefore, is of unusual interest.

Astronomical Topics

New Minor Planet. A very interesting new minor planet 1933 HH, of the tenth magnitude, has been discovered at Johannesburg. Berlin R.I. Circ. 779 gives the following orbit deduced by H. E. Wood and Mr. Jackson:

Epoch 1933 May 8·0 U.T.

$$\left.\begin{array}{ll} M & 193{\cdot}5890^\circ \\ \omega & 157{\cdot}0834 \\ \Omega & 335{\cdot}9980 \\ i & 7{\cdot}6191 \\ \varphi & 23{\cdot}5206 \end{array}\right\} \quad 1925{\cdot}0$$

$$\begin{array}{ll} n & 2863{\cdot}962'' \\ a & 1{\cdot}15333 \end{array}$$

Ephemeris for 0^h U.T.

	R.A.			N. Decl.	
June 1	0^h	18^m	30^s	1°	1′
,, 9	0	34	48	3	10
,, 17	0	51	18	5	22
,, 25	1	8	12	7	37

The object appears to resemble planet 1932 HA in that it comes inside the earth's orbit at perihelion, but it is now near aphelion.

Seasonal Changes on Jupiter. The axis of Jupiter is so nearly upright to its orbit plane that seasonal changes in the usual sense cannot be conspicuous. There are, nevertheless, certain changes traceable on its surface that approximate in period to its orbital revolution. Mr. A. Stanley Williams, who has been a regular observer of the planet for about half a century, has recently given (*Mon. Not. Roy. Astro. Soc.*, March) a study of the changes in rate of rotation of the north tropical current on Jupiter. He notes that this region is free from disturbing influences such as are present in the zone of the great red spot, so that there is more chance of detecting seasonal effects. The study covers half a century, 1881–30, and includes observations from all available sources. The graph shows evidence of a periodic change of rate, with maxima in 1888 ($9^h55^m40^s$), in 1904 ($9^h55^m32^s$), in 1919 ($9^h55^m30^s$), and in 1928 ($9^h55^m33^s$). There were well marked minima in 1911 ($9^h55^m17^s$) and 1922 ($9^h55^m21^s$). The author has used also a few observations made in 1835 and 1862, and deduces that the length of the cycle of change is 12·4 years, and that in the mean the epochs of minimum period, or maximum velocity, are given by the formula $1909{\cdot}9+12{\cdot}4E$. The period given is distinctly longer than the time of revolution, which is 11·862 years, but the interval covered by continuous and exact observations is scarcely long enough for the excess to be regarded as established. It is still more in excess of the average sunspot period; this has been suspected to be associated with some of the changes on Jupiter, but apparently the changes in rotation time are not correlated with it.

Illumination of Nebulosity surrounding a Nova. Mr. B. M. Peck contributes a paper on this subject to the February number of the *B.A.A. Journal*. Many attempts have been made to obtain the parallaxes of novæ by the rate of expansion of the surrounding nebula. There are, of course, two cases: that of an actual driving out of nebulous matter, and that of the rendering visible of previously existing clouds. The paper discusses the latter case and shows that the circle of visible nebulosity first expands to a maximum radius, and then contracts again to a point; the times of expansion and contraction are equal. During expansion the light is highly concentrated towards the centre, during contraction it tends to become uniform. The outburst is assumed to occur within the nebula. The results will be similar in kind if the nebula is behind the nova, but if it is in front of it there will be no contraction. The paper treats the subject analytically.

Central American Research by the Carnegie Institution

A FEATURE to be noted in the most recent developments of archæological research in the field is an increase in specialisation, and where financial considerations will permit, the supplementing of the purely archæological work by research in other branches of science which can be made to assist in the interpretation of archæological results in their bearing on the general problem of the history of man and the development of his culture, whether considered regionally or in its broader aspect. Thus Dr. A. V. Kidder, in his report as chairman of the Historical Section of the Carnegie Institution of Washington (Year Book No. 31), remarks: "It is difficult to escape the conviction that only by coordinated research involving the cooperation of all the disciplines devoted to the study of man and the collateral support of many biological and physical sciences can we attain understanding of any given episode in human history."

It is on these broad lines that the Carnegie Institution is now promoting the study of the archæology of Central America. Investigations which were undertaken originally as a study of the archæology only of the Mayas of Yucatan, have been expanded to embrace, in addition, on an ordered scheme, the geology, geography and climatology of the area, the physical characters of the inhabitants, their physiological characters and liability to disease, their ethnological affinities, their languages and their mode of life and culture.

At Chichen Itzá, the principal zone of interest of the Institution in Yucatan, Dr. S. P. Morley was engaged in the examination of a building known locally as the 'Mercado', although there is no reason to think that its original use was that of a marketplace. It was probably a purely ceremonial building. It consists of a single vaulted chamber, no less than 250 ft. long, in which the architect had given full play to technically daring and bold ideas. Thus the vault is 15 ft. wide, the broadest span yet recorded for the Maya area. The building displayed the weakness of all other Maya buildings in placing too great reliance upon columnar beams of wood to carry the huge weight of the stone superstructure. The roof crashed even before the abandonment of the city; but its fall preserved intact a remarkable altar on which was sculptured in relief and brilliantly painted a procession of elaborately costumed captives, marching towards a centrally enthroned figure.

A second major undertaking at Chichen Itzá was the exploration of a building known as the 'Monjas' by Mr. John S. Bolles—a problem of considerable complexity, owing to the fact that a building, originally small, had been continually enlarged by alterations and additions until it became a veritable puzzle in massive masonry. Even on a superficial examination it showed five distinct periods of architectural modification.

From Chichen Itzá an expedition was sent to investigate the newly discovered site of Calakmul in the archæologically unknown region of south central Campeche. Two weeks were spent there. The site proved to be that of a very extensive Old Empire city, remarkable for the unprecedented number of its monuments. The dates of nearly fifty were deciphered, ranging from A.D. 364 until A.D. 550. It was evidently colonised from Peten. Its situation midway between Peten and northern Yucatan gives it great archæological importance.

Next to Chichen Itzá, the Institution's most important archæological centre in the Maya field is Uaxactun, an Old Empire city in Northern Peten, Guatemala, where work has been carried on since 1924. It was the oldest and longest-inhabited centre of Maya culture. Stratified deposits have been uncovered going back far beyond the first stone-carved records. Here, in what is known as the *A* group of buildings, a palace was excavated by Mr. Ledyard Smith. This is a type of building in the Old Empire of which very little is known. It was found to consist of four courts surrounded by cell-like structures. The greatest height of the building as it now stands is nearly 50 ft. The north court and main court were excavated and were found to be on different levels and connected by stairways. A number of pyramids were also examined, and were found to contain burial vaults which yielded much valuable pottery.

Advantage was taken of the temporary residence of Dr. S. K. Lothrop in Guatemala to engage him in carrying out a preliminary archæological investigation of the Highlands of that area.

In the collateral studies, to which reference is made in the beginning of the report, Guatemala was on this occasion made the principal centre of activity. Geographical reconnaissances were made by Dr. Wallace W. Atwood, president of Clark University, and Dr. Rollin S. Atwood of the University of Florida, the former undertaking the definition of the physiographic provinces of the Highlands, with special reference to Lake Atitlan and adjoining territory; while Dr. Rollin Atwood made a detailed geographical survey of the region of Chichicastenango.

A medical expedition worked in Yucatan under Dr. George M. Saunders, collecting information upon the various forms of malaria and amœbic dysentery. The prevalence of three types of malaria was demonstrated, as well as an infestation with the amœbæ causing dysentery. The medical expedition to Guatemala under Dr. George G. Shattuck had as its objective a general knowledge of the diseases prevalent in the Highland area and the collection of material for comparison with the low-lying Yucatan Peninsula, especially with reference to the Indian population. In Guatemala, as in Yucatan, the Indians showed an extraordinary resistance to the virus of syphilis.

At Chichen Itzá, Dr. Steggerda made a study of the amount and character of the food of the modern Maya and continued his study of their anthropometry, more especially with respect to growth and genetic study. Dr. Davenport also made an inspection with the view of gauging the possibilities of Yucatan as a field for genetic study.

In the ethnological field Dr. and Mrs. Asael Hanson made a study of the *barrio* of Santa Ana, a part of Merida which has recently undergone great changes towards urbanisation. In linguistics the work was confined to the study of material collected in previous seasons.

Notwithstanding these varied activities, Dr. Kidder notes a number of further problems in topography, geology and climatology which are especially urgent; while in biology, he says, the field "has hardly been scratched".

Alcohol Through the Ages

THE jubilee memorial lecture of the Society of Chemical Industry, which had this title, was given by Dr. E. F. Armstrong and has since been published (*J. Soc. Chem. Ind.*, March 24 and 31). Dr. Armstrong dealt in a very detailed and interesting manner with the production of alcohol and its industrial applications.

The process of distillation was known to the Ancients, though the earliest records of its application for obtaining concentrated alcohol for use by the Arabian doctors of medicine date from the tenth century. Concentrated spirit was prepared by Raymond Lully (born 1235) by dehydration with fused potashes, the name 'alcohol' being used for it by Libavius in 1597. The synthesis of alcohol from ethylene was effected by Henry Hennell in 1827–28. Methylated spirit for manufacturing purposes was legalised in 1855, and in 1902 the use of other suitably denatured alcohol for special purposes was permitted without duty.

In the manufacture of industrial alcohol, fermentation processes still hold the field, but are becoming menaced by the probability of the industrial production of ethanol (ethyl alcohol) from ethylene. The raw material for fermentation (cane sugar molasses, potatoes, sugar beets, maize, grain) varies in different countries. A pure culture of yeast is used and the fermentation is rigidly controlled, the carbon dioxide evolved being utilised in the United States by solidification to form 'dry ice' for refrigeration purposes. Attempts to use sawdust have been made, and in 1930 large quantities of alcohol (about half being used as motor fuel) were made in Sweden from the waste liquors of works producing paper from wood pulp.

Synthetic alcohol (ethanol) can be made from ethylene or from acetylene, but the latter process, once used in Germany, has been abandoned. Ethylene is present in the gas formed in the 'cracking' (thermal decomposition under pressure) of petroleum with the production of petrol. In one process used in the United States, the gas contains 28 per cent of ethylene, with other unsaturated hydrocarbons which can again be cracked to give ethylene with fair yields. Whereas abundant ethylene is available in the United States there is little or none produced at present in this way in Great Britain.

The conversion of ethylene from coke oven gas into alcohol has for some time been carried out in France, the reactions being those used by Hennell:

$$(1)\ C_2H_4 + H_2SO_4 = C_2H_5.HSO_4\ ;$$
$$(2)\ C_2H_5.HSO_4 + H_2O = C_2H_5OH + H_2SO_4,$$

the hydrolysis of the sulphovinic acid being carried out with steam and the diluted sulphuric acid used to make ammonium sulphate with synthetic ammonia. Large quantities of alcohol (4 million gallons up to the end of 1931) have been made from ethylene in the United States at a conversion cost, probably, of 1*s*. per gallon.

Another possible, but still uneconomic, process starts with water gas, containing carbon monoxide and hydrogen. In presence of a catalyst under high pressure, methyl alcohol (methanol) is the normal product:

$$CO + 2H_2 = CH_3OH,$$

but by using a special catalyst, some ethanol is also produced.

In considering the industrial applications of ethanol, Dr. Armstrong referred to its use as a motor fuel in conjunction with petrol, and practically every country has provided by legislation for the production of this fuel. The manufacture of power alcohol is comparatively neglected only in the British Empire, except Southern Rhodesia, Natal and Queensland. The production of absolute alcohol by direct distillation was made possible by the researches of Sidney Young, but these were neglected for some years; the process is now largely used in France and the United States by concerns which have extensive patent rights. Many foreign governments are making the use of alcohol compulsory in order to save money from being spent abroad on petroleum products. The London General Omnibus Co., Ltd. has made extensive trials with mixtures of benzol and alcohol, and the use of alcohol fuels has long passed the experimental stage. The use of alcohol would provide a market for surplus agricultural products. Ether, aldehyde, acetone and acetic acid are all produced from alcohol on the technical scale.

International Commission for the Polar Year, 1932–33

THE International Commission for the Second Polar Year held its third meeting in Copenhagen on May 15–20, under the presidency of Dr. D. la Cour. Representatives from Denmark, Norway, Sweden, Finland, Germany, France, Italy, Holland, Great Britain (Dr. Simpson and Prof. S. Chapman), the Department for Terrestrial Magnetism of the Carnegie Institution of Washington and the U.S.A. Coast and Geodetic Survey attended. No representative from the U.S.S.R., which is taking a large part in the work of the Polar Year, was able to attend.

The report of the president showed that the great enterprise of the Polar Year is being very successful, and that the present unsettled conditions of the world are not having the adverse effects which one feared. At least forty stations north of latitude 55°, of which thirteen are north of latitude 70°, are recording the earth's magnetic field, most of which are using the remarkable quick run magnetographs designed by Dr. la Cour in addition to the more usual self-recording instruments. Three new magnetic stations have been established in the southern hemisphere, at Elisabethville by Belgium, at Cape Town by the University of Cape Town and at Magellanes by Chile, but the work in the southern hemisphere is somewhat disappointingly small.

All the magnetic stations are also taking meteorological observations and a large number of established meteorological stations have augmented their normal observations. The aurora is being studied in greater detail than it has ever been before. The auroral atlas prepared by Prof. C. Størmer has played a large part in the organisation of auroral work and with its help the observations are being made in a systematic manner which will greatly facilitate the discussion of the results. Simultaneous photographs of the aurora from observing points twenty or more miles apart, for the accurate determination of the position of the aurora in the atmosphere, are being made at several stations, amongst which the British station at Fort Rae is one of the most successful, more than 4,000 pairs of simultaneous exposures having already been obtained there.

The investigation of the temperature of the high atmosphere has been greatly facilitated by the use of *radio-sondes*, instruments which emit radio-signals while being carried on free balloons, from which the temperature at each height can be determined. More than two hundred such instruments have been supplied and brought into use at the different observing stations.

For the first time, explosions are being organised in high latitudes, in order to investigate the travel of sound waves through the upper atmosphere under polar conditions. These observations give information about the temperature conditions at much greater heights—40 km. or more—than can be reached by instruments carried on balloons. A grant of 40,000 dollars by the Rockefeller Trust for the purchase of magnetic instruments and *radio-sondes* and the training of observers in their use has been of the greatest value; without this grant it would have been impossible to make observations in many parts of the world, and the investigations of the earth's magnetic field and of the temperature of the upper atmosphere would have been much less complete than they will be now.

The International Union of Scientific Radio-Telegraphy has organised an intense study of the ionosphere during the Polar Year, and the reports of the work of the British station at Tromsö is of outstanding interest and importance, a constant record being obtained of the height and intensity of the reflecting layers.

Without going into further detail, it will be clear that the scientific work during the Polar Year will be of immense value for the solution of many problems of geophysics.

The main work of the Commission was concerned with making plans for the early publication of the results obtained during the Polar Year and their ultimate discussion. The actual working up and publication of the observations must be undertaken by the various countries which have been responsible for making them; but the Commission feels it essential that there should be some central body to direct and facilitate the discussion of the results. For example, it is highly desirable that copies of all the magnetic registrations, taken throughout the world during the Polar Year, should be available at some central place for the convenience of investigators; that a list or index of all the observations made during the Polar Year should be prepared and published so that workers on any problem may know what data are available and where they can be found. The Commission considers that the best way to obtain this end would be to continue its functions after the end of the Polar Year and a resolution to this effect was passed.

The prosecution of the work of organising the discussion of the results will involve considerable expense. As no funds at present exist for such a purpose, the Commission could only express the hope that the necessary money will be made available.

In all, the Commission passed nineteen resolutions and there can be no doubt that very valuable organising work was accomplished.

The King of Denmark received the members of the Commission and expressed his great interest in the work of the Polar Year.

University and Educational Intelligence

CAMBRIDGE.—Dr. R. O. Redman, of St. John's College, has been appointed University lecturer in the Department of Astrophysics and Mr. J. A. Ratcliffe, of Sidney Sussex College, University lecturer in the Department of Physics. Dr. N. Feather, of Trinity College, and Mr. P. I. Dee, of Sidney Sussex College, have been appointed University demonstrators in the Department of Physics.

Candidates for the Michael Foster studentship in physiology are requested to send in their applications, with a statement of the course of research they propose to undertake, to Prof. J. Barcroft, Physiology School, before the end of June. The student receives the annual value of the fund (about £100) and may be re-elected for a second year.

Under the will of Mr. Arthur Marmaduke Shield, who died in 1922, a considerable sum of money was left to the Medical School for the foundation of a scholarship in human anatomy and for the general purposes of the School. A report of the Faculty Board of Medicine has recommended the foundation of the studentship and that the remainder of the bequest should be devoted to the foundation of a readership in pharmacology to be called the Shield readership in pharmacology. The Board wishes to offer the directorship of the sub-Department involved to Prof. E. Mellanby, professor of pharmacology in the University of Sheffield, and, in view of his distinction and present position, it seems appropriate that he should be given a personal professorship which will terminate with his tenure of the office.

DURHAM.—A new lectureship has been added to the Department of Geology, to which Miss Doris L. Reynolds has been appointed. Miss Reynolds was formerly on the staffs of the Queen's University, Belfast, of Bedford College, London, and of University College, London; and her published studies of the sedimentary and igneous rocks of the north of Ireland are well known to petrologists.

LONDON.—The title of professor of philosophy in the University has been conferred on Dr. L. S. Stebbing, in respect of the post held by her at Bedford College.

THE British Government has decided to participate in the management of the International Bureau of Technical Education, and Mr. A. Abbott, formerly chief inspector of technical education, has been nominated as its representative on the Administrative Council and Mr. E. G. Savage, chief inspector of technical education, as correspondent with the Bureau. The address of the Bureau is: 2, Place de la Bourse, Paris, 2e.

THE eighth Summer School organised by the British Social Hygiene Council will be held at St. Hugh's College, Oxford, on July 27–August 3. The study programme includes four lectures in biology by Mr. D. Ward Cutler and Dr. N. J. T. M. Needham, five in psychology by Prof. A. E. Heath and Dr. William Brown, five in anthropology by Prof. R. Firth and Miss Monica Hunter and three in physiology by Dr. Agnes Scott. Other lectures and discussions will deal with prostitution, the unemployed adolescent, problems arising in residential institutions for young people and developments in colonial education. The courses of lectures should prove of special interest to teachers. Further information can be obtained from the Secretary, British Social Hygiene Council, Carteret House, Carteret Street, S.W.1.

APPLICATIONS are invited for the following scholarships administered by the Council of the Institution of Electrical Engineers, of which awards will be made this year: Duddell Scholarship, value £150 per annum, tenable for three years, open to British subjects less than nineteen years of age on July 1, 1933, who wish to take up a whole-time day course in electrical engineering; Ferranti Scholarship, value £250 per annum, tenable for two years, open to British subjects less than twenty-six years of age on July 1, 1933, who are students or graduates of the Institution and desire to carry out whole-time research or post-graduate work; Swan Memorial Scholarship, value £120, for one year, open to British subjects less than twenty-seven years of age on July 1, 1933, who desire to carry out whole-time research or post-graduate work; Silvanus Thompson Scholarship, value £100 per annum and tuition fees, tenable for two years, for works employees; open to British subjects less than twenty-two years of age on July 1, 1933. The successful candidate will be required to take up a whole-time day course in electrical engineering at an approved university or technical college. Inquiries for full particulars and nomination forms (specifically mentioning the name of the scholarship) should be addressed to the Secretary of the Institution, Savoy Place, London, W.C.2.

A CASE for a "Colonial Educational Conference" was made out by Sir George Maxwell, formerly Chief Secretary, Federated Malay States, in a speech made on April 11 at a meeting of the Educational Circle, Royal Empire Society. The importance in colonial administration of paying due regard to indigenous languages, customs and traditions and the view that the language is "the most adequate exponent of the soul of a people" have been often stressed in recent years, notably by the Phelps-Stokes African Commission of 1924 and in memoranda issued in 1927 and 1930 by the Colonial Office Educational Advisory Committee but, said Sir George Maxwell, "Memoranda are not enough". The primary concern of the suggested conference, as of the educational conference of the French Colonial Exhibition of 1931, would be the adaptation of education to the needs of the colonies and it would deal with such matters as: a linguistic educational survey, textbooks, vernacular training schools for teachers, vernacular trade and artisan schools, extent of demand for higher schools and a university; and the power of the colony to assimilate the product. On some of these, light will perhaps be thrown by the series of special lectures to be given at the summer school organised by the British Social Hygiene Council to be held at Oxford on July 2–August 3, on the work of colonial administrators with special reference to the educational aspect. This same problem of the adaptation of education to the needs of a community with a cultural heritage radically different from western civilisation is dealt with at some length in "The House of the People", an account of Mexico's new "schools of action" published by the United States Government Printing Office, Washington (pp. 73, price 10 cents).

Calendar of Nature Topics

South-West Monsoon in India

From November to April the prevailing winds over India blow from the north-east, but during April the direction is reversed and from May to October the winds blow mainly from west in the Arabian Sea and from south in the Bay of Bengal. Among sailors these alternating winds are known as the north-east and south-west monsoons, from an Arabic word meaning seasons. In India, however, the 'monsoon' means rather the annual rains which fall during the period of the south-westerly winds. The latter begin in May, but in this month the amount of moisture in the air is only sufficient to cause scattered thunderstorms. The real monsoon rains begin in June, when powerful streams of air sweep across India from the west on the west coast of the Deccan and from the south in Bengal. Each of these currents has a well marked 'front', which brings the first heavy rains, usually with thunder. The arrival of this front is the 'burst' of the monsoon, which is often heralded by a weak cyclonic depression in the Arabian Sea or Bay of Bengal. The burst of the monsoon occurs early in June on the west coast and on about June 15 in Bengal; normally by the end of June the monsoon is established over the whole of India.

Spring in Northern Europe

In temperate countries the change from winter to summer takes place gradually and often fitfully through a much-varying spring. In higher European latitudes, within the line of the Arctic Circle, the transition is more abrupt and produces startling changes in the countryside. There is a sudden upheaval in early June and, within a few days, the hillsides, previously snow-clad, stream with rushing torrents. Wide patches of earth appear and grow rapidly green. Alpine and other flowering plants follow quickly in profusion, and the sunlit landscape glows with colour. Millais (1919) has recorded that on the north coast of Norway no birds were seen before May 25 except resident ravens and magpies together with various gulls. During the next ten days the first spring arrivals appeared—flocks of snow buntings, redwings, fieldfares, shore larks, and the Greenland wheatear. Soon after the beginning of the ice break in the first week of June, several pairs of long-tailed duck and a pair of red-throated divers were noted. The advent of migrants continued throughout June, until the dotterels, buntings and other late-comers reached summer quarters. On June 6, 1916, Millais witnessed, near Hammerfest, the courtship of the bluethroat. A female was joined by two brilliant males, whose gorgeous throats shone like jewels in the sun. They went through a leaping courtship somewhat similar to the courting behaviour of the common redbreast.

Spawning-Time of the Sturgeon, and the Need for Protection

Formerly the rivers of Poland were famous for the abundance of their sturgeon (*Accipenser sturio*), and of these perhaps the most famous was the Vistula, where a quarter of a century ago large catches were made. Now the numbers have fallen seriously: on the lower Vistula, in Pomerania, the years 1929–32 yielded 65 individuals, the middle regions during

1925–32, 36. The weight percentages caught in different months were :—April 14 per cent, May 37, June 18, August 2, September 2 ; which means that already in April sturgeon are present abundantly in the Vistula and that in August the migration is over. The heaviest individuals appear in April and May, and after June and July the weight suddenly falls, an indication that the latter are the spawning months, since the weight of roe makes up about 20 per cent of the total body weight. The actual spawning grounds in the Vistula have never been discovered.

Now the only area in which a close season is enforced is Pomerania, and there the close season runs from July 15 until August 31 ; so that during the very time when the river ought to be left undisturbed for spawning, fish are liable to be caught. The close season should be extended in area, and also in time to cover the spawning period, say from June 1 to the present closing date. Although destruction of sturgeon for food has had something to do with the growing scarcity of the species, it must not be forgotten that still more is its disappearance due to the pollution of the rivers by the refuse of industrial and human centres. (Wlodzimerz Kulmatycki, in *Ochrona Przyrody*, Warsaw, 12, 8 ; 1932.)

The Spring Flush

Pastures are now approaching the peak of their productivity in England and the skill of the grazier is shown in the most economical conversion of the plentiful growth of grass into a saleable form. The problem has always been recognised as a difficult one, namely, the adjustment of the balance between the interests of the pasture and the grazing stock. Writing of the utilisation of grazing land, Arthur Young says : "There are two opinions directly contrary to each other : first it is asserted by one set of graziers, that, let the grass to be fed consist of ever so many acres, that the cattle should have it all at once. Secondly the other set advance that large fields of fifty, eighty or an hundred acres should be divided, that the farmers may change his stock from one to another and give the grass fresh and fresh".

The difficulty of putting these rival theories to the test seemed insuperable to Arthur Young, on the ground of soil variation and individuality in the grazing stock. Only recently, more than a century after the above was written, are scientific methods of the evaluation of herbage by their botanical composition and the performance of grazing stock being worked out. The difficulties are still there, but modern technique in the field, and the treatment of the data by statistical methods, enables valid conclusions to be drawn from data which present the high degree of variability associated with living material. New aspects of the utilisation of grass land are continually coming to light, and no crop is at present so much in favour for scientific research.

The outstanding feeding value of young grass, the superior qualities of selected strains of the native grasses and clovers, and the extraordinary influence which the grazing animal can exert on the direction of development of a pasture, are all recently established points of first rate importance in grass land management. Pasture management can never be a rule of thumb operation but the time is rapidly approaching when graziers will have a body of well-established principles at their command, in place of the rival opinions no less tenaciously held now than in the time of early writers.

Societies and Academies

LONDON

Physical Society, April 7. A. H. BLATCHFORD : The diffraction of X-rays by liquid sulphur. The X-ray diffraction effects given by liquid sulphur at various temperatures between 130° C. and 260° C. indicate an unstable grouping of atoms of sulphur which becomes less pronounced with increased temperature, and changes in form gradually up to 220° C., when there is a sudden alteration corresponding to the change from the form S_λ to S_μ. Raman and Ramanathan's theory of X-ray scattering by liquids is applicable to some extent at temperatures near the melting-point. E. GWYNNE JONES : The hyperfine structure of perturbed series. Rules governing such effects are derived. It is found that these rules are not analogous to those obtained from the analysis of multiplet structures. A. J. BRADLEY and A. H. JAY : Quartz as a standard for accurate lattice-spacing measurements. A test has been made of the use of quartz as a standardising substance for very accurate lattice-spacing determinations. With copper-K_a radiation it gives a very good photograph with many sharp K_a doublets, which may be measured with accuracy. A redetermination of the axial ratio from an X-ray powder photograph gave $c/a = 1{\cdot}10002 \pm 0{\cdot}00004$, and this value was confirmed by X-ray measurements on several other crystals. Assuming Bergqvist's value for d_{100} (4246·02 X units) it was found that $a = 4902{\cdot}9$ x., $c = 5393{\cdot}3$ x. The values of d_{100} at 18° C. for different specimens all lay between $4245{\cdot}9_5$ and $4246{\cdot}3_0$. L. H. MARTIN and K. C. LANG : The thermal conductivity of water. The parallel-plate method was used over the range 7°–60° C., the apparatus being especially designed to cope with the difficulties which arise in the measurement of the conductivity of a volatile liquid. Two series of measurements were made, the plates in one apparatus having approximately three times the area of those in the other.

Society of Public Analysts, May 3. S. G. WILLIMOTT : An investigation of solanine poisoning. In two districts of Cyprus there is a practice of eating potato shoots and leaves as vegetables, and last year an epidemic of poisoning was traced to this cause. The amount of solanine found in the green shoots of the Irish potato plants consumed in these cases was more than five times the quantity present in the tubers of the same plants. It was found that the solanine content of potato shoots diminishes as the altitude at which the plant is grown increases. Habitual consumers of potato shoots probably acquire immunity to the alkaloid. F. E. HUMPHREYS and H. PHILLIPS : Examination of leather for the presence of extractable chromium compounds. In view of the fact that cases of dermatitis have been attributed to the wearing of chrome-tanned leather, experiments have been made to ascertain the amounts of chromium compounds which can be extracted from various types of chrome leather, under conditions similar to those which the leather encounters during wear. Chrome leathers suspected of causing dermatitis did not contain a greater quantity of water-extractable chromium than did normal leather, but many chrome leathers might irritate the skin of a person particularly sensitive to chromium compounds. Solutions resembling sweat in composition do not remove much more chromium, either as chromate or trivalent chromium compounds, than does water, although slightly acid solutions tend to extract slightly larger amounts than neutral solutions. W. M. Seaber: Barium as a normal constituent of Brazil nuts. Barium occurs as a normal constituent of Brazil nuts, the amounts found in 14 samples of the shelled nut of different seasons ranging from 0·02 to 0·31 per cent. As a rule, Para nuts contain less than Manaos nuts. Nearly the whole of the barium is in an insoluble form, but a considerable proportion of it can be extracted by 0·15 per cent hydrochloric acid, and with higher concentrations of acid it is practically all dissolved. Herbert Hawley: The phytosteryl acetate test as a routine method for examining butter fats. A method is described in which the sterols are directly extracted from a small amount of butter fat by shaking with chloroform and an alcoholic solution of digitonin, and then converted into acetates the melting point of which is determined. The method will detect 5 per cent of vegetable fat in butter or ghee.

Royal Meteorological Society, May 17. D. Brunt: The adiabatic lapse-rate for dry and saturated air. The equation giving the saturated adiabatic lapse-rate is derived as an energy equation, and a slight approximation makes it possible to reduce this to a form suitable for direct computation. The results obtained are represented graphically. An alternative derivation of the fundamental equation for rising saturated air is given, which, by assuming the principle of entropy from the beginning, reduces the derivation to very brief compass. C. S. Durst: Notes on the variations in the structure of wind over different surfaces. Over the sea, the short-period fluctuations in wind are greater in tropical air than in polar air, although when inversions of any magnitude occur over the sea, smooth-flowing air can persist with higher velocities than over agricultural land. An example is shown of the structure of wind over desert, and the frictional churning of the air due to a town is examined; the effects on temperature are found to be appreciable. C. E. P. Brooks and Theresa M. Hunt: Variations of wind direction in the British Isles since 1341. Regular observations of wind direction began near London in 1667, at Edinburgh in 1731 and at Dublin in 1725, and extend, with gaps in the earlier periods, to the present day. Over nearly the whole series the prevailing wind has blown from about west-south-west, but abnormally frequent easterly winds were recorded during the period 1740–48 in London and Dublin and during the period 1794–1810 in London. The present century has been remarkable for the persistence of south-westerly winds. Before 1667, observations are scanty but Merle's diary shows a dominant wind from west-south-west in the years 1341–43, while there is good evidence that easterly winds were abnormally frequent during the latter half of the sixteenth century.

Leeds

Philosophical and Literary Society, March 3. R. Whiddington and J. E. Taylor: Inelastic scattering of electrons in helium at zero angle. Experiments on electron impacts, energies between 40 and 400 volts, with helium atoms have been carried out, the inelastically scattered electrons at zero angle receiving special attention. It is shown that for the 2^1P excitation: the probability is very approximately a linear function of the energy of the incident electrons between about 40 and 400 volts energy; the probability of excitation falls to zero at an energy somewhat greater than that corresponding to the critical excitation energy; and the excitation probability is definitely lower than that predicted by recent theories. R. Whiddington and T. Emmerson: Scattering of electrons in helium. The experimental and theoretical results so far published indicate that both the inelastic and elastic scattering of slow electrons in helium rise to a maximum for zero scattering angle. Using fine electron beams and narrow slits together with magnetic spectrum analysis and photographic recording, results have been obtained at smaller angles than those hitherto investigated, which show a maximum probability at a small angle with a low probability at zero angle. R. Whiddington and F. C. Poultney: Energy of the beams in electron diffraction. The experiment of G. P. Thomson on the velocities of electrons diffracted by passage through a thin film has been repeated. Greater resolving power is obtained by using 90° deviation, when the circular rings become elliptical but are found to remain symmetrical about the central spot. Consequently it is deduced that the velocities are the same to within 0·30 per cent. No trace of diffracted electrons of energy less than that of the main beam is found. Edmund C. Stoner: Interatomic distances and ferromagnetism. Slater's suggestion as to the variation with interatomic distance of the sign and magnitude of the interaction integral is discussed with reference to the relative values of the interaction in the ferromagnetic elements, the change in volume on magnetisation, the variation of atomic moment in alloys of ferromagnetic elements, and the effect of manganese on the atomic moment in nickel manganese alloys. E. C. Pollard: Law of force between neutron and proton. The increase of the heights of nuclear potential barriers with the increase in atomic number is discussed from the point of view of the content of the nucleus; if a polarisation field is assumed between neutron and proton, the experimental figures permit the calculation of the 'polarisibility' of the neutron. This is done. A. W. Foster: Some measurements of the thermoelectric powers of nickel and nickel-chromium alloys in the neighbourhood of their Curie points. The thermoelectric powers of some nickel-chromium alloys have been accurately measured between 100° C. and 450° C. and the destructive effect of small amounts of chromium on the change at the Curie point in nickel confirmed. J. Grainger and Rachel M. Heafford: Some effects of the ordinary tobacco mosaic upon the developmental anatomy of the host plant. Many virus diseases cause a mottling of yellow and dark green areas to appear upon a leaf. The anatomy of these several areas has been studied by many workers who have examined cross sections of the leaf. A recent paper by the authors (*Proc. Leeds Phil. Soc.*, 2, No. 9, 1933), describes the anatomy as revealed by examination in planes parallel to the surface, and also shows the various stages of development of mosaic diseased and healthy leaves. The presence of the virus has the general effect of slowing down the rate of vacuolation of leaf tissues, but it also causes irregularities to appear. The hypothesis is advanced that the anatomical features associated with light green and dark green areas of a diseased leaf can be explained by different relative rates of vacuolation in the upper epidermis, the palisade, the spongy parenchyma and the lower epidermis.

PARIS

Academy of Sciences, April 18 (*C.R.*, 196, 1153–1176). M. GIGNOUX and L. MORET: The prolongation in Haute-Savoie and in Switzerland of the structural units of the Dauphiny Alps. D. VAN DANTZIG: The fundamental group of compact abstract groups. SAINTILLAN: Forces of inertia of a system and a carrying along movement. R. TREMBLOT: A variable star with eclipses of short period. The star *BD.* 10·838 (Henry Draper Catalogue, *H.D.* 26909) has been recently shown by C. Hoffmeister to be a variable with very short period. The author's observations from January until March, 1933, confirm this and suggest that the variability is due to two stars and not to one star rotating on itself. MME. RÉCHID: Study of the thermal decomposition of ammonium phosphate. MLLES. M. MONTAGNE and G. ROUSSEAU: The preparation of the anils of fatty ketones. HENRI LAGATU and LOUIS MAUME: The comparative composition, in the vine, of homologous leaves taken respectively from stems carrying fruit and stems deprived of their grapes. The leaves from stems carrying grapes are poorer in lime, nitrogen and potash but richer in phosphoric acid than the homologous leaves from sterile branches. A. MAGNAN and A. SAINTE-LAGUË: Analysis of the 'hovering' of the *Volucella*. E. FOURNEAU, M. and MME. J. TREFOUËL, D. BOVET and PIERRE KOETSCHET: Chemicotherapy of infections with *Trypanosoma congolense*. The selective action of polyarsenical organic compounds.

CRACOW

Polish Academy of Science and Letters, Jan. 9. L. CHWISTEK, W. HETPER and J. HERZBERG: (1) The fundamentals of rational metamathematics. (2) Remarks on the fundamentals of rational metamathematics. M. JEZEWSKI and J. KAMECKI: The dielectric constants of aqueous electrolytes. The dielectric constants of solutions of various electrolytes have been measured at concentrations varying from zero to 0·01 *N*. K. DZIEWOŃSKI and L. STERNBACH: The reactions of α-naphthylamine with benzoyl chloride. MLLE. J. ACKERMANN: The innervation of the skin of *Amblystoma mexicanum*. Z. KOLODZIEJSKI: The transplantation of young larvæ of axolotl on adult animals. L. W. WISNIEWSKI: Remarks on the systematics of the family of Coitocæcidæ. T. VETULANI: Researches on the types of Arab horses raised in Turkey.

GENEVA

Society of Physics and Natural History, Feb. 16. F. CHODAT and M. JUNQUERA: The reduction of methylene blue by an *Endomyces* at the expense of its endocellular hydrogen donators. The authors study the variations of the reducing activity of *Endomyces Chodati* in the system: methylene blue (acceptor), living yeast (ferment), in the absence of an extra-cellular hydrogen donator (Thunberg's technique, MacIlvaine's buffer mixture, temperature, 40° C.). The optimum conditions of *p*H, and of the age of the organisms are described. α-Monobromacetic acid, even when added in high concentrations, is without effect on the enzymatic process. M. GYSIN: Petrographic researches in the Haut-Katanga. (2) The formations of the Kundelungu. In the south-east part of the Haut-Katanga, the Kundelungu is represented from bottom to top by a schisto-grit dolomitic and clay conglomerate (tillite), by limestones and dolomite massifs, dolomitic grits with a little felspar and clay, by lustrous schists sometimes containing grit and by felspathic and dolomitic grits passing to quartzites. The author gives the correlations between these formations and those recognised in northern Rhodesia and in the cupriferous district of the Katanga. He then describes the petrographic constitution of these different rocks. A. LOMBARD: The Virgulian and the stratigraphy of the Portlandian of the Col du Marchairuz region. The Virgulian in the neighbourhood of the Col du Marchairuz and the Monts de Bière (Vaudois Jura) has been described by various geologists. Completing these data, the author demonstrates that this sub-stage is reduced to zero to the south-west of the Marchairuz. It is then impossible to distinguish the lower Portlandian from the upper Kimmeridgian. The upper Portlandian is characterised by marly limestones, important dolomitic levels and cargneules. The latter increase in thickness from north-east to south-west. The dolomitic layers diminish. H. PAILLARD and R. DUCKERT: Researches on the catalytic oxidation of acenaphthene. The authors have studied the oxidation of acenaphthene in solution in various solvents by the action of compressed oxygen and in the presence of catalysts capable of giving oxides of nitrogen. Under these conditions the only important oxidation product is naphthalic acid. H. PAILLARD and P. FAVARGER. Researches on the chlorination of acenaphthene. The authors have studied the action of chlorine on acenaphthene and the conditions necessary for obtaining a good yield of 5-chloroacenaphthene. A. PERIER: The influence, in a homogeneous ethnic group, of the variation of the cephalic index on that of the alveolo-palatinal and superior facial indices. The superior facial and alveolo-palatal indices show no correlation with variation of the cephalic index. Hence their relative stability, a disharmony inasmuch as the most brachycephalic skulls, are, proportionally, the most leptene and the most leptostaphyline. G. TIERCY: The respective phases of minimum ionisation and light minimum in the Cepheids. The author attempts to show how the combined effect of the curve of radial velocities, of that of light and of the theory of radiating equilibrium affords an explanation of the fact that the minimum ionisation phase precedes the light minimum.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Wednesday, June 7

FOLK-LORE SOCIETY, at 8—(at University College, Gower Street, W.C.1).—Mrs. E. S. Drower: "Mandean Magic, White and Black". (*Discussion*).

Thursday, June 8

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 2.—Sir George Buchanan: "International Hygiene" (succeeding lecture on June 9).*

UNIVERSITY COLLEGE, LONDON, at 2.30.—Sir Flinders Petrie: "Egyptian Links with the Past" (to be repeated on June 10 at 3, and June 13 at 5.30).*

ROYAL COLLEGE OF PHYSICIANS OF LONDON—(Croonian Lectures).—Prof. E. Mellanby: "Nutrition and Disease—the Interaction of Clinical and Experimental Investigations" (succeeding lectures on June 13 and 15).

Friday, June 9

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 2.—F. Radcliffe: "Factory Medical Work".*

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.—N. H. Mummery: "The Practice of Industrial Medicine".*

ANNUAL CONGRESS OF THE SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES, June 7–10. Prof. E. J. Salisbury—president.

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Royal Society of Edinburgh, Session 1932–1933. Vol. 53, Part 2, No. 10: Spermatogenesis in *Drosophila obscura* Fallen, 1: The Cytological Basis of Suppression of Crossing-over. By Dr. P. Ch. Koller and Thelma Townson. Pp. 130-143+3 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 2*s*.

The University of Sheffield: Research Department for the Cold Working of Steel and other Ferrous Metals. Reports to December 1932. Pp. 72. (Sheffield.)

The Empire Journal of Experimental Agriculture. Vol. 1, No. 1, April. Pp. 96. (Oxford: Clarendon Press; London: Oxford University Press.) 7*s*. 6*d*. net.

Royal Astronomical Society. List of Fellows and Associates, 1933 March. Pp. 45. (London: Royal Astronomical Society.)

Proceedings of the Royal Society. Series A, Vol. 140, No. A841, May 3. Pp. 241–483. (London: Harrison and Sons, Ltd.) 12*s*.

The Transactions of the Worcestershire Naturalists' Club. Vol. 8, Part 5, 1928–1931. Edited by Carleton Rea. Pp. v–x+295–392+123–139. (Worcester.) 10*s*.

Joseph Priestley, 1733–1804. By Dr. Robert Martin Caven. Pp. 25+6 plates. Chemistry and Life. (The Fourth Gluckstein Memorial Lecture, 1932.) By Sir Frederick Gowland Hopkins. Pp. 21. The Chemist in the Far East. By Alexander Marcan. Pp. 18. (London: Institute of Chemistry.)

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1932. Pp. iv+512+54+57+12 plates. (London: H.M. Stationery Office.) 15*s*. net.

Agricultural Progress: the Journal of the Agricultural Education Association. Vol. 10, 1933. Pp. 252. (Cambridge: W. Heffer and Sons, Ltd.) 5*s*. net.

Proceedings of the Royal Irish Academy. Vol. 41, Section A, Nos. 5-6: The Frequency Distribution of Resonance Radiation, by Dr. R. W. Ditchburn; The Transmission of Resonance Radiation through a Gas (Steady State), by Dr. R. W. Ditchburn. Pp. 41–60. 1*s*. 6*d*. Vol. 41, Section B, Nos. 10–11: The Synthesis of Diflavones, by Dr. Joseph Algar, Isabella B. McCarthy and Eveline M. Dick; The Action of Ammonia on Ethyl Malonate and Ethyl Malonamate, by Dr. Kenneth C. Bailey. Pp. 155–167. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1498 (T.3218): Spinning Calculations on some Typical Cases. By H. B. Irving and A. S. Batson. Pp. 26+10 plates. 1*s*. 6*d*. net. No. 1501 (Spin. 70, 70a, T.3243): Tests of Floating Ailerons on a Bristol Fighter Aeroplane. Part 1: Rolling Balance Tests, by F. B. Bradfield and G. F. Midwood; Part 2: Full Scale Tests, by A. V. Stephens. Pp. 26+20 plates. 1*s*. 9*d*. net. (London: H.M. Stationery Office.)

Report of the National Baby Week Council, 1932: presented and adopted at the Sixteenth Annual Meeting of the National Baby Week Council held in London on the 22nd March, 1933. Pp. 26. (London.)

The Ninety-ninth Annual Report of the Royal Cornwall Polytechnic Society. New Series, Vol. 7, Part 2, 1932. Pp. xiii–xxvi+107–202+xvi. (Camborne.) 5*s*.

Proceedings of the Cambridge Philosophical Society. Vol. 29, Part 2. Pp. 165–318. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

Armstrong College, Newcastle upon Tyne: Standing Committee for Research. Report, Session 1931–1932. Pp. 42. (Newcastle upon Tyne.)

North-Eastern Rhodesia: Geodetic Survey of South Africa. Vol. 6: Report on the Measurement of the Arc of the Thirtieth Meridian in North-Eastern Rhodesia. Executed by Dr. T. Rubin under the direction of Sir David Gill. Pp. 123. (London: H.M. Stationery Office.) 10*s*. net.

The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report, 1932, East Malling Research Station, Kent, 1st January 1932 to 31st December 1932. Pp. 163+11 plates. (East Malling.) Free to Associate Members; to Non-Members, 3*s*. 6*d*.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 72, No. 437, May. Pp. 365–460+xviii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Memoirs of the Cotton Research Station, Trinidad. Series A (Genetics), No. 5: Cytological Studies in Cotton, 1: The Mitosis and Meiosis in Diploid and Triploid Asiatic Cotton. By A. Skovsted. Pp. 227–251+plates 8–11. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*.

Board of Education. Educational Pamphlets, No. 93: An Experiment in Rural Organisation. Pp. 35+4 plates. (London: H.M. Stationery Office.) 9*d*. net.

Journal of the Royal Statistical Society. Vol. 96, Part 2, 1933. Pp. viii+183–380. (London: Royal Statistical Society.) 7*s*. 6*d*.

Proceedings of the Linnean Society of London, Session 1932-33. Part 2. Pp. 49–104. (London Linnean Society.) 2*s*.

OTHER COUNTRIES

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University (Publications de la Faculté des Sciences de l'Université Masaryk). Čís. 169: On the Bodily Differences between Sprinters and Non-Sportsmen (A Study of 100 Students from different Grammar Schools in Brno). By Dr. R. Malafa. Pp. 11. (Brno: A. Píša.)

Práce Moravské Přírodovědecké Společnosti. Svazek 8, Spis 4, Sign. F68: On the Question of Human Races on the Basis of the Precipitin Test and Isoagglutinations (Eskimos, Kalmuks, Gipsies, Europeans including Jews). By Prof. V. Suk. Pp. 42. (Brno: A. Píša.)

Transactions of the Mining and Geological Institute of India. Vol. 28, Part 1, April. Pp. 65. (Calcutta.) 4 rupees.

Scientific Papers of the Institute of Physical and Chemical Research. No. 414: On the Constitution of Phosphorescence Centres in Fluorite. By Satoyasu Iimori. Pp. 189–200. 25 sen. Nos. 415–421: On the Constitution of Stachyose, a Tetrasaccharide obtained from *Stachys tuberifera* N_D, by Motoi Onuki; Nutritive Value of Sperm Whale Oil and Finback Whale Oil, by Yoshikazu Sahashi; On the Ergosterin Content of various Edible Mushrooms in Japan, by Midzuho Sumi; Narkotin und Vitamin C, von Suttekiti Maruyama; The Thermoluminescence Spectrum of Calcite, by Satoyasu Iimori; Note on the Spectra of PbII, HgI, SbI, CdI and InI, by Kiyoshi Murakawa; Dependence of *K* Lines of Elements from Cu to Ti on Chemical Combination, by Sanae Yoshida. Pp. 210–310. 95 sen. (Tokyo: Iwanami Shoten.)

Travaux de la section de Géodésie de l'Union Géodésique et Géophysique Internationale. Tome 8: Rapports généraux établis à l'occasion de la quatrième assemblée générale, Stockholm, 11–23 août 1930. Pp. vi+136+16+79+24+85+14+32+28+5+24+ii. (Paris.) 120 francs.

Journal de la Société des Américanistes. Nouvelle Série, Tome 24, Fasc. 2. Pp. xxix+221–446. (Paris.)

Proceedings of the Imperial Academy. Vol. 9, No. 3, March. Pp. v–vi+83–142. (Tokyo.)

The Geology and Underground Water of Rangoon (with Special Reference to Tube-Wells). By P. Leicester. Pp. iv+78+10 plates. (Rangoon: Government Printing and Stationery Office.) 15 rupees: 22*s*. 6*d*.

Mineral Resources: British Guiana. Particulars *re* Geological Formation and Surveys, Previous Workings, Communications, Transport, etc., in the North West District, Mazaruni and Puruni District, Potaro—Essequibo District. Pp. 64. (British Guiana: Department of Lands and Mines; London: The Crown Agents for the Colonies.) Free.

National Research Council of Japan. Report No. 10, April 1930—March 1931. Pp. ii+351-391+6. (Tokyo.)

Koninklijke Vereeniging "Koloniaal Instituut" Amsterdam. Twee en twintigste Jaarverslag 1932. Pp. 116. (Amsterdam.)

Sveriges Geologiska Undersökning. Ser. C, No. 376: Den järnmalmsförande lagerserien i sydöstra Skåne. Av Assar Hadding. Pp. 39. 1.00 kr. Ser. C, No. 377: Vemdalskvartsitens ålder. Av Bror Asklund. Pp. 56. 1.00 kr. Ser. C, No. 378: Bidrag till kännedomen om kambrium och ceratopygeregionen inom Storsjöområdet i Jämtland. Av. Per Thorslund. Pp. 11. 0.50 kr. (Stockholm: P. A. Norstedt and Söner.)

Annual Report of the Harbour Commissioners of Montreal for the Year 1932. Pp. 121. (Montreal: Harbour Commissioners of Montreal.)

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 5, No. 3: The Problems of the Diffuse Matter in the Galaxy. By J. S. Plaskett and J. A. Pearce. Pp. 167–237. 50 cents. Vol. 6, No. 6: The Minimum Masses of Three Spectroscopic Binary Stars. By J. A. Pearce. Pp. 49–58. Vol. 6, No. 7: The Spectroscopic Orbits of the Four Helium Stars H.D. 29376, H.D. 39698, H.D. 44701 and H.D. 208095; The Radial Velocity of Boss 5028. By J. A. Pearce. Pp. 59–77. Vol. 6, No. 8: The Orbits of Four Spectroscopic Binaries. By W. E. Harper. Pp. 79–91. (Ottawa: F. A. Acland.)

Publications de l'Observatoire de Genève. Rapport sur les concours de réglage de chronomètres de l'année 1932. Par Prof. Georges Tiercy. Pp. 25. (Genève.)

Department of Agriculture: New South Wales. Veterinary Research Report. No. 6, Part 3 (December 1931). Pp. 93–136+4 plates. (Sydney: Alfred James Kent.)

CATALOGUES

Catalog and Price List of Eastman Organic Chemicals. (List No. 24.) Twenty-fourth edition. Pp. 108. (Rochester, N.Y.: Eastman Kodak Co.)

Monel Metal and Nickel in the Chemical and Allied Industries. (MHS.) Pp. 16. (London: Henry Wiggin and Co., Ltd.)

Heffer's Book Adviser, or What shall I Read? No. 2, April. Pp. 24. (Cambridge: W. Heffer and Sons, Ltd.)

Gardens and Gardening, Botany (General and Cryptogamic), Local Floras, Forestry, Timber, etc. (Catalogue No. 208.) Pp. 44. (London: Dulau and Co., Ltd.)

Watson's Microscope Record. No. 29, May. Pp. 24. (London: W. Watson and Sons, Ltd.)

Some Examples of "Vidi" Illustrations. Pp. 12. (London: The Kathleen Boland Studio.)

The Nickel Bulletin. Vol. 6, No. 5, May. Pp. 63–82. (London: The Mond Nickel Co., Ltd.)

Liver Extract B.D.H. (for Injection) in the Treatment of Pernicious Anæmia by Intramuscular Injection. Pp. 4. (London: The British Drug Houses, Ltd.)

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Telegraphic Address: PHUSIS, LESQUARE, LONDON

Co-operative Industrial Research

THE Committee on New Industrial Development last year considered a proposal for the creation of a new national research organisation particularly to assist in the industrial development of ideas, inventions, or processes likely otherwise to remain undeveloped in Great Britain, and thus to close what was alleged to be a definite gap in our existing organisation of research. With this proposal the Committee did not agree and the opinion was recorded that the proposed organisation, the suggested functions of which would go far beyond the organising and undertaking of research, would be superfluous and more likely to cause confusion than to forward the cause of scientific research in industry. Although the Committee's reasons for rejecting this proposal were soundly and convincingly argued, the report did not suggest that the organisation of research in Great Britain was by any means perfected and the Committee indicated indeed points at which much wider use might be made of existing facilities.

On the other hand, a paper like that read a little while ago by Sir Harold Hartley, when he reviewed scientific research on the London Midland and Scottish Railway, gives such an impressive picture of the possibilities in co-operative research already existing in Great Britain that an optimistic view of their resources is easily engendered. It is clear, however, from the reports of the Advisory Council which directs the work of the Department of Scientific and Industrial Research that, while the framework may exist, it has not yet been developed to an extent commensurate with either national or industrial needs. Because the existing facilities are not being adequately used, dangerous gaps do in fact exist between pure science and manufacture, and certain industries are a long way from considering seriously how scientific knowledge can be utilised in their processes. Only in one or two spheres has the Department as yet been able to survey national resources as a whole and to endeavour to provide a basis upon which production and consumption could be planned as a scientific whole, in some such way as was advocated by Sir Arthur Salter at McGill University recently. The development of new industries based on a full knowledge of scientific resources and an economic scientific cooperation with other countries might well build a new industrial Britain.

If, however, one of the most important steps to be taken in closing this gap is the education of industry to appreciate the contribution which science can render to its everyday needs, there are other directions too in which action seems to be called for. To one of these Dr. A. J. V. Underwood and Prof. W. E. Gibbs recently directed attention in a letter to the *Times*, and Dr. Underwood has since elaborated his ideas in an article entitled "Some Thoughts on Industrial Research" which appeared in the *Chemical Trade Journal* on March 17. Apart from the fundamental scientific research which in the main is the field of the universities, and the industrial research which is concerned with the improvement of processes or the development of new products, Dr. Underwood directs attention to the position in Great Britain of industries too small to support a research association, and to the facilities which exist for research on problems which in scope are far beyond the limits of a single industry.

Dr. Underwood advances no evidence to show that the requirements of the small industry could not equally well be met by utilising the resources, for example, of the National Physical Laboratory or the National Chemical Laboratory, and a proposal to establish an institute for the benefit of industries or firms too small or backward to provide for their own research resources cannot command much support at the best of times. As example of his second point, Dr. Underwood cites the unit processes of chemical engineering, such as drying, filtration, evaporation, mixing, grinding, which are basic in many industries and differ in their application mainly in the materials handled, and here he is on much firmer ground.

Dr. Underwood urges that research in such fields should be conducted on as wide a basis as possible, so that any developments and advances would be available to all the industries concerned and progress in one industry be reflected in other entirely non-competitive industries. On this ground he advocates the establishment of an Institute for Industrial Research on the lines of the Mellon Institute in the United States, and claims that in such fields the proposed institute would offer great advantages in efficiency, economy and the interchange and discussion of ideas among scientific workers. Particularly he stresses the desirability of establishing it in close association with a university, and the value of the institute to firms too small to justify the formation of a separate research association.

It is thus clear that the Institute Dr. Underwood has in mind is something quite distinct from the proposal considered last year by the Committee on New Industrial Development. On the other hand, the Department of Scientific and Industrial Research, as indicated in its current report, has endeavoured with some success to foster fundamental research of this type in fields of common interest to a number of industries. Even in the particular field of chemical engineering used by Dr. Underwood as example, much useful co-operative work is already being done, in which the Department of Scientific and Industrial Research itself is prominent. Examples of this are afforded by the activities of the National Physical Laboratory or of the Non-Ferrous Metal Industries, the British Refractories, and the British Electrical and Allied Industries Research Associations among the research associations, or in the work of the various research boards such as those concerned with fuel problems, building research, radio research, lubrication, etc. There is already in existence a good deal of machinery for co-operative industrial research which might with advantage be more extensively used particularly in regard to exchange of information on non-competitive matters. Organisations like the Association of British Chemical Manufacturers and the British Standards Institution in their work on industrial safety and standardisation of practice are also assisting in the development of habits of co-operation and encouraging the exchange of information on common problems.

Nevertheless, it is difficult to resist the feeling that Dr. Underwood has put his finger on a weak spot in our national structure, whether or not it is desirable to create a fresh organisation or institute to meet the needs. The development of one or more of our schools of chemical engineering to undertake work on such fundamental problems might well prove a more satisfactory alternative and one consistent alike with the existing structure of our national research organisation and with the relations between academic and industrial research which exist in other fields. Obviously such development can only be satisfactorily secured if it is planned in relation to national and not merely sectional or local demands, and success will depend on the enlistment of adequate industrial as well as Government support.

The advantages which Dr. Underwood stresses for his scheme in regard to exchange of ideas and discussion among scientific workers, the more efficient utilisation of expensive equipment, and the more effective training of recruits for this particular field are too important to be lightly dismissed. They are points which find an essential place in any definite policy or scheme for scientific and industrial research planned in relation to the national resources and needs as a whole. Whether these needs to which Dr. Underwood directs attention are met within the framework of our existing organisation, or whether it proves necessary to create a new institute for the purpose, a much more adequate conception of the place of research in the organisation and development of our national and industrial resources will be demanded of industry as a whole as well as of Government departments. Industry must learn, too, to relinquish the obsolete ideas of trade secrecy, and to co-operate as fully and wholeheartedly as possible in the exchange of information in investigations of those many problems which are common to divers industries and indeed to many departments of our national or municipal life. Already there are signs that the idea of service is permeating large scale industry to a remarkable extent and the growth of this spirit affords the surest foundations on which not only to build an adequate national structure for scientific and industrial research but also to secure, both within industry and without, that fellowship and understanding between the worker in pure and applied science which is the surest passport to success.

Astrolabes

The Astrolabes of the World: based upon the Series of Instruments in the Lewis Evans Collection in the Old Ashmolean Museum at Oxford, with Notes on Astrolabes in the Collections of the British Museum, Science Museum, Sir J. Findlay, Mr. S. V. Hoffman, the Mensing Collection, and in other Public and Private Collections. By Dr. Robert T. Gunther. Vol. 1: *The Eastern Astrolabes.* Pp. xvii + 304 + 68 plates. Vol. 2: *The Western Astrolabes.* Pp. viii + 305 – 609 + plates 69–153. (Oxford: Printed at the University Press, 1932.) £10 10*s*. net.

THE Oxford University Press has produced for Dr. Gunther two sumptuous volumes. The binding is elegant, the paper is good, the print, except in the facsimile of Morley's description of a planispheric astrolabe, is clear, and the numerous photographic plates are exceedingly beautiful; these number no less than 153 in addition to 217 figures. There could scarcely be a book better fitted to lie as an ornament on a library table, and there could scarcely be a book better fitted to be left unread. Wherever I have been able to check the author, I have found him careless both in his statements and in the correction of the press. Of the latter fault there are two examples in the preface. Not all the erudition of the University Press readers has saved Dr. Gunther from the solecism *De Astrolabii Canones*, repeated not indeed in all, but unhappily in most of the passages where the name of Robertus Anglicus's work occurs. In the same sentence the subject 'pages' is followed by the singular 'is'. The Table of Contents not only repeats the incorrect title of Robertus Anglicus's work, but also gives us 'Severas Sabokt' for Severus Sabokt, and in five places it substitutes 'Bleau' for Blaeu. After fifty pages of a mechanical facsimile of Morley's work, the author's own qualities are displayed again. On p. 53 the very name of the instrument to which the volume is devoted is given as *ἀστρολάβον* instead of *ἀστρόλαβος*. On p. 59 Prof. Jenkin has become Prof. Jenkins, the date of his astrolabe being variously given as 1925, 1927, and 1928. Dorotheus of Sidon changes sex and becomes Dorothea. After this one cannot complain of a variation between Philopon, Philoponus, and Philopons.

The errors on the history and literature of the astrolabe are more astonishing. The references to Chaldean fragments, to the object found off Anticythera, and to the early invention of the *arachne* are irrelevant. The author seems to know little of the evidence connecting Ptolemy with the astrolabe and implies that it was among the discoveries codified in the Almagest. Misled by a clerical error on the part of Mr. Dalton, whom he does not cite for his statement, he places Ptolemy in the first century A.D. He argues that "the philosopher who invented the astrolabe", mentioned by Severus Sabokt, must be older than Ptolemy, because the former uses the ancient value of 24° for the obliquity of the ecliptic, whilst Ptolemy adopted 23° 51′. Here he overlooks the fact that, in his treatise on the planisphere, Ptolemy suggests the use of the round quantity, 24°. Our principal authority for the early history of the astrolabe, Synesius, seems to be known to Dr. Gunther only at third hand. At all events he gives a quotation by Mr. Dalton of a quotation by W. S. Crawford from the original. He is in error in supposing that Synesius's gift to

Pæonius was an astrolabe. It was a planispheric star-map. He is also in error in supposing that Synesius claimed to have invented the planispheric astrolabe. He claimed that under the guidance of Hypatia he had perfected the theory of the planisphere. John "Philopon" is dated on p. 59 "about the time of the Great Fire at the Library (A.D. 642)", in spite of all that Gibbon has done to disprove the legend of that fire. Of course Philoponus should have been dated a century earlier. On p. 568, however, Philoponus appears as a Greek author in the reign of the Palæologi who rescued several fragments of Persian and Arabian science by translating them into Greek. Nicephorus Gregoras, a fourteenth century writer on the astrolabe, is dated 758–828.

Dr. Gunther's information about the Renaissance literature is equally unreliable. He prints an imposing bibliography, but does not name his sources. It must contain many books that he has never seen. He states that the early work "De Astrolabio" attributed to Proclus was printed at Venice in 1491. The work in question was certainly by Proclus, but it does not mention the planispheric astrolabe, with which alone Dr. Gunther is concerned. It is Georgius Valla's translation of the sixth chapter of the Hypotyposis, and it was printed not in 1491, but in 1498. 1491, as Harles suspected, and, as Mr. Strickland Gibson has kindly verified for me, is merely a misprint for 1498 in the Bodleian Catalogue of 1674, corrected in all later editions. The work is, in fact, part of the collection of translations by Georgius Valla, which Dr. Gunther notices separately, mixing nominatives and genitives in his own way. He has failed to discover that in the same volume Valla gives under the name of Nicephorus Gregoras not only the actual treatise by that writer, but also an older treatise, attributed in some MSS, I think erroneously, to Ammonius, the Greek text of part of which was edited by Hase under the name of Ægyptius along with the text of Philoponus. He has missed altogether the Basle volume of 1544, in which a composite work appears, consisting partly of chapters translated by Valla from the Hypotyposis of Proclus, partly of a translation by Valla of Philoponus's treatise on the astrolabe, partly of chapters supplied by Valla himself.

On the descriptions of individual astrolabes I have little to say, but I would warn readers to be cautious in accepting identifications of saints and to compare with the plates any erroneous letters or figures attributed to the astrolabes in the text. It is to be hoped that it was not Dr. Gunther who "englished" the inscription given on p. 234, including the phrase, "the consumer of the pertinacy".

The two volumes contain work, however, by others than Dr. Gunther. Morley's most scholarly and most valuable description of a planispheric astrolabe has been noticed already. The late Mr. H. W. Greene contributed a translation of the treatise of Philoponus on the astrolabe. Here we must admire the translator's courage as well as his scholarship. Unfortunately he was unable to discover from Liddell and Scott's Lexicon that ἐξάπλωσις in the first sentence of that work means not 'explanation', but 'projection', making plane, not making plain. Mrs. Margoliouth has given us a combination of her own learning with that of Nau in her translation of Severus Sabokt. She has certainly made her author very clear. There are also two instructive chapters by Theodor Wåhlin on astrolabe clocks and on the availability of the astrolabe for the construction of sundials.

We have also to thank Dr. Gunther for printing a mediæval Latin version of Arzachel's treatise on the Saphea, for reprinting the treatises by Bate and Hermannus Contractus, and for reproducing in facsimile parts of the treatises of Robert Tanner and Robertus Anglicus.

The true history of the origin of the astrolabe is best read in Synesius's epistle to Pæonius. He states, probably on the authority of Hypatia, that Hipparchus, the first to attack the theory of the planisphere, had given a mere sketch of his subject. He attributes to him the insertion of sixteen stars on "the instrument". Ptolemy and his successors were, according to Synesius, content with the practical application of the theory and found these sixteen stars sufficient for time-finding (ὡροσκοπεῖον) at night. Now a planisphere used for finding time at night by means of stars marked on it can scarcely be anything but a planispheric astrolabe. It is natural to suppose that Hipparchus's planisphere, showing the sixteen stars, was also designed for finding the time at night by observing them. But that is not directly stated. Ptolemy himself appears to have mentioned the planispheric astrolabe once only, "Tetrab." iii. 2, where he refers to the time-finding (ὡροσκόπιος) astrolabe as giving a better determination of time than the gnomon or the water-clock. Philoponus informs us that Ptolemy inserted the temporal hours in the planispheric astrolabe. These were the hours in popular use. It should be noted, however, that the planispheric astrolabe is never mentioned by Ptolemy either in the Almagest or, where we should have expected to find it, in his treatise on the planisphere, preserved in a Latin translation of an Arabic translation. There is no mention of it in the published works of Pappus and Theon, or in Proclus. Evidently it was not regarded as an instrument of precision. Heliodorus records an occultation of Saturn, A.D. 503 February 21, where he and Ammonius observed the time of emergence in temporal hours with an astrolabe. This was certainly the planispheric astrolabe. Ammonius, as Philoponus informs us, wrote a treatise on the planispheric astrolabe. Philoponus's own treatise based on this has been mentioned above.

Ammonius, though we know of nothing to connect him with astrology, did in a sense provide the medieval astrologer with all the equipment that he needed. His perpetual ephemeris or "Canonion", called Almanack by the Arabs, gave the places of all planets referred to the ecliptic. The astrolabe gave without computation the reduction from the ecliptic to the horizon, and with the planetary places referred to these two systems of co-ordinates the astrologer could construct his theme. J. K. F.

Central African Volcanoes

Geological Survey of Uganda. Memoir No. 3: *The Volcanic Area of Bufumbira.* Part 1: *The Geology of the Volcanic Area of Bufumbira, South-West Uganda; with Notes on the Petrology and Economic Geology.* By A. D. Combe and W. C. Simmons. Pp. xi + 150 + 12 plates. (Entebbe: Government Printer, 1933.) 15*s.*

IN the brief preface to this new volume, one to be placed side by side with the authors' memoir on the Ankole tin, the Director of the Uganda Geological Survey notes the importance of the area described, distinguished by a recent volcanic activity far grander than the lingering remnants that remain to-day, and suggests, as we are seldom reminded when African volcanoes are concerned, the possibility of renewed outbursts. He mentions also the fact that its leucite-bearing lavas represent, perhaps, one of the largest potash reserves in the world. Moreover, gold has been found.

Part 1, now issued, contains the account of the field geology and the geographical studies of Messrs. Combe and Simmons; Part 2, by Prof. Holmes and Dr. Harwood, is promised in about twelve months and will deal with the chemical and theoretical sides involving petrogenesis, a continuation, we may suppose, of their recent work on the Toro volcanics to the north.

Bufumbira, about one-tenth of the entire field, is situated in the extreme south-west of Uganda and is continued under other names into the Belgian Congo and the mandated territory of Ruanda, the whole being frequently referred to as the Mufumbiro Mountains, but in this memoir as Birunga, the Lunya-ruanda word for volcanoes. Nowadays volcanic activity is extinct in British territory, but Nyamlagira and Ninagongo are active in the west and two others erupted lava in 1905 and 1912 respectively.

The geological structure of the area is comparatively simple; the eruptions have forced their way through the slates and quartzites of the Karagwe-Ankolean system, and the interest of the field is bound up in the composition of the lavas, for the content of potash is unusual, though shared to some extent with the Toro area.

Owing to their position athwart the Central African trough between Lakes Kivu and Edward, the Bufumbira flows built a barrier which dammed the streams flowing north along a pre-Rift depression and formed the southern lake. Three smaller lakes similarly came into existence. Eleven types of lava are shown on the geological map, varying from the enstatite-andesites of Sabinyo, the oldest volcano, to more basic successors usually containing olivine, such as the leucite-basalts. Huge flows of leucite-basanite are commonest.

In addition to three major volcanoes, thirty-four smaller cones have been mapped, usually steep-sided, 200–500 ft. high and built of ash and scoria—in other words, explosion vents. Such safety outlets also occur along ridges of ash and breccia corresponding in direction with the regional strike of the steeply dipping beds of the Karagwe-Ankolean system, indicating lines of weakness, an interesting peculiarity.

The comparative youth of the field, for the most part middle or late Pleistocene, has allowed of an exactitude in observation and resulting precision not so easily accomplished, for example, amongst the volcanoes of Kenya, and it is interesting to note that during distinct periods of activity lavas of different appearance and composition may be produced from a given vent, or the reverse; thus leucite-basalt may be succeeded by leucite-basanite, with intervening limburgite, or vice versa. On the other hand, no change may occur during successive eruptions. The authors record that a traverse from Kisenyi on Lake Kivu to Nyamlagira showed the lavas were melilite-leucite-nephelinites, quite different from the Uganda rocks, where melilite is absent and nepheline very rare.

One peculiarity of the area deserves mention as having possibly a bearing on puzzling occurrences elsewhere, namely, the boulder deposits occupying the pass between Sabinyo and Mgahinga, consisting entirely of masses of lava derived from the first, but lying on flows derived from the second.

Sabinyo is without a remnant of a crater and, as remarked, is the oldest volcano of the area. The deposits are 10–25 ft. thick, the boulders 5 ft. and occasionally 10 ft. in diameter and have moved some two and a half miles from their source. Combe, who visited the Java volcanoes, compares the Uganda deposits to the streams of mud, sand and boulders, called 'lahar', which are ejected from the throat of a volcano charged with steam or gases or with the waters of a crater lake or excessive rain. The latter 'wet' type of lahar, which is known to have moved eighteen miles from its source, presents a close similarity to the Uganda occurrences. Connexions between the deposits and deep erosion valleys cut in Sabinyo are noted, but the precise explanation of the means whereby the boulders reached their present position remains undefined.

Gold, together with tin and wolfram, occurs in the north of the area. Development is still in the prospecting stage, but a noteworthy point, perhaps only of academic interest, is that the gold is found in the Karagwe-Ankolean rocks, usually considered the repository of cassiterite and the associated minerals, a fact which the work of Kitson in the Kavirondo country has already suggested to be possible. The metal as found is usually coarse, yet the ultimate source has still to be discovered, and again we may meet with that crucial point of alluvial prospecting in Central Africa, the possible reversal of an earlier drainage.

The authors are to be congratulated on the results of their painstaking observations, the Uganda Geological Survey and its director on the manner in which letterpress, plates and the excellent coloured map have been reproduced.

JOHN PARKINSON.

Public Analysts and the Food Industry

The Society of Public Analysts and other Analytical Chemists. Some Reminiscences of its First Fifty Years, by Bernard Dyer, and A Review of its Activities, by Dr. C. Ainsworth Mitchell. Pp. viii + 278 + 4 plates. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1932.) 12*s*. 6*d*. net.

IT would be difficult to find a greater contrast than exists between the condition of the food industry now and its condition when the Society of Public Analysts was instituted, the history of which up to the time of its jubilee is recorded in this interesting book. Adulteration of the grossest order was then rife: many dealers sought only to make profits, utterly regardless of the quality of their goods or the effect their sophistications might have on the health of those who consumed them. The idea of a merchant or manufacturer employing a chemist to check the purity of supplies or to make suggestions for the improvement of wares or products would have been scouted as an absurdity; and the recently created 'public analysts' were regarded as the natural enemies of the dealer, and looked on with fear and suspicion.

Now, though adulteration is not extinct, and though it has taken on more subtle forms, yet it has greatly diminished in extent. The manufacture and the merchanting of foodstuffs are for a great part in the hands of large and reputable firms, who employ big chemical staffs, for control both of incoming and outgoing goods, and for research with improvement as its aim, and who are banded together into associations, one of the objects of which is to protect the trade against its less scrupulous members; and the public analysts are looked on, by all except those less scrupulous members, as friends and helpers in the task of supplying the public with pure and nutritious food.

This change has come to pass gradually. Many causes have contributed to it; not the least the activities of the public analysts themselves, individually and through their Society; and the history of the process by which it has been brought about is contained in this book. Dr. Dyer's experience as a member of the Society goes back practically to its foundation; and his happy gift of narrative, and the kindly human nature that peeps through his periods, give a fascination to the perusal of the tale, and will make it interesting reading, not only to those professionally or scientifically concerned with analytical chemistry, but also to any reader who takes an intelligent interest in the things that touch and affect our daily life.

It only remains to say, in the short space available, that Dr. Mitchell's chronological summary of the work of the Society, arranged according to subjects, and dealing not only with the composition of foods and with methods for their analysis, but also with the legal aspects of food adulteration, is a most valuable piece of annotated bibliography, and that Miss Elliott's very detailed index makes it very readily available. J. T. Dunn.

Short Reviews

Incunabula of Tannin Chemistry: a Collection of some Early Papers on the Chemistry of the Tannins reproduced in Facsimile and published with Annotations. By M. Nierenstein. Pp. v + 167. (London: Edward Arnold and Co., 1932.) 12*s*. 6*d*. net.

This elegant volume will delight chemists and botanists who are interested in the history of their subjects. Dr. Nierenstein has made the study of tannin chemistry peculiarly his own, and it was a happy inspiration that led him to select and reproduce the early classical articles in this field of research. His facsimiles include two pages of a 1485 "Hortus Sanitatis"; an excerpt from Baptista Porta's "Natural Magic", describing a method of writing upon eggs by means of galls and alum; Piepenbring's paper "Ueber die Säure der Galläpfel", 1786; Davy's article on "Different Methods of obtaining Gallic Acid", 1805; and papers by Pfaff, Biggin and others.

The facsimiles are followed by eight pages of historical, chemical and bibliographical annotations, in which Dr. Nierenstein's erudition is employed to advantage but not paraded. We learn that the earliest scientific data on the chemistry of the tannins were due to Tachenius, who in 1677 expressed the view that the black colour produced on mixing extract of galls with a solution of green vitriol was to be explained by supposing that the galls contained an alkali that "doth suck up the *Acid Spirit* of the *Vitriol*". Gallic acid was discovered in 1787 by Scheele, while the estimation of tannin was first successfully elaborated by Biggin in 1799.

Dr. Nierenstein has a sly poke at those who believe in certain interrelationships between the tannins and the resins, remarking that this error of Bouillon-Lagrange "still survives and has its supporters amongst those who write on the tannins, but have not worked on this subject". We congratulate Dr. Nierenstein upon his handsome contribution to historical chemical literature, and his publishers and patrons for their enterprise in publishing and subsidising it.

Through Wonderlands of the Universe. By R. K. Golikere. Pp. xviii + 400. (Bombay: D. B. Taraporevala, Sons and Co.; London: Kegan Paul and Co., Ltd., 1933.) 6.4 rupees.

Here is a compendium of information dealing with our universe from the world in which we live to the most distant stars. Its author tells us it is "a simple elementary study" but it contains the speculations consequent upon the researches of Jeans, Eddington and Jeffreys to which we would scarcely have applied the term "elementary". Yet so clever a form has been adopted that every part of the book is intelligible both to laymen and to "junior students" of science. Our Norman period is usually headed '1066 A.D.', and here most chapters have headings with some figure in feet or miles. Each such figure is followed by a note on the subject, the most striking and modern facts and thoughts thereon. The land surface thus has a series of 135 height headings and the ocean 46 depths. There is a deliberate lack of order in arrangement of these facts—or a very clever conception of human psychology. It is rather boring to have the depths of oceans reeled off in rotation by a lecturer or printed in a column, but if these are interspersed as here with the maximum depths of fish, corals, sponges, starfishes, submarine cables, etc., about each of which there is a pleasant little story, the facts remain with us.

The author is the devoted pupil of Jeans, who is often quoted and discussed. The last chapter is on Hindu cosmogony and cosmography and this we would like extended, a view with which we are convinced most Hindu readers will agree. It is good to see expositions of the far-reaching conceptions consequent on the researches of science and to have these blended with the more striking phenomena in our planet and its civilisation.

Mr. Golikere is brave and original and hence well deserving of success; he is never dull and this is the best that can be said of any author.

La géologie et les mines de la France d'outremer. Recueil de conférences organisées au Muséum par les soins du Bureau d'Études géologiques et minières coloniales sous le haut patronage de A. Lacroix, et avec le concours de L. Bertrand, F. Blondel, J. Bourcart, A. Demay, M. Dreyfuss, L. Dubertret, P. Fallot, M. Glasser, H. Hubert, Ch. Jacob, L. Joleaud, A. Lacroix et L. Neltner. Pp. viii + 604. (Paris: Société d'Éditions Géographiques, Maritimes et Coloniales, 1932.) 70 francs.

The great mining and metallurgical industries of France recently formed a committee to study the mining possibilities of the French colonial empire. This committee established a Bureau d'Études géologiques et minières coloniales, which, with the collaboration of the French Government, was charged with the training of specialists for the investigation of the mineral deposits of the Empire, and with the education of the French public, especially the official and financial fractions thereof, in regard to the possibilities of their overseas possessions. With this latter end, a series of lectures was given during last winter at the Muséum d'Histoire Naturelle by geologists familiar with the different French colonies. These lectures have been collected in the present work and issued by the Bureau.

The volume is the first general study of this kind dealing with the French possessions. The geology and mineral resources of each colony are set forth in detail and the volume will be of great use to geologists, since a synopsis of this kind has been hitherto exceedingly difficult to make. Those interested in the relative distribution among the nations of the minerals necessary for large-scale modern industry will find in this book food for anxious thought.

Objektive Spektralphotometrie. Von Dr. L. S. Ornstein, Dr. W. J. H. Moll und Dr. H. C. Burger. (Sammlung Vieweg: Tagesfragen aus den Gebieten der Naturwissenschaften und der Technik, Heft 108–109.) Pp. vi + 146. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1932.) 10.80 gold marks.

THIS addition to the well-known "Sammlung Vieweg" monographs is published at a time when considerable attention is being given by spectroscopists to measurements of spectral intensity. It is for this reason, in the first instance, very welcome. The prestige of its authors in this particular field of work gives it at once considerable value. The many workers who are unable, for various reasons, to acquire first-hand experience of the technique of the school founded by Prof. Ornstein at Utrecht cannot do better than study this book. We are here given precisely the kind of information which anyone desirous of undertaking research in this field would wish to possess.

In addition to the principles underlying, and the actual technique of, spectro-photometry with photographic plates, several useful chapters are included. The thermal and the photoelectric methods of measuring radiation are dealt with in some detail. The photographic plate and the factors upon which its blackening depends are treated well. A separate chapter deals with the micro-photometer and its applications. The practical character of this monograph should make it widely appreciated. R. C. J.

Handbuch der Spectroscopie. Von Prof. H. Kayser und Prof. H. Konen. Band 8, Lieferung 1. Pp. iv + 654. (Leipzig: S. Hirzel, 1932.) 67.50 gold marks.

KAYSER'S "Handbuch der Spectroscopie", in particular vols. 5 and 6, have been of inestimable service to generations of spectroscopists. The earlier volumes, owing to the rapid development of the subject, are generally regarded by the modern worker as of historic interest only. There must always be a place of value for a compilation of reliable data such as at the time of publication vols. 5 and 6 represented. Vol. 7 and, now, vol. 8 (both in collaboration with Prof. Konen) are an admirable attempt to bring up to date this aspect of the subject of spectroscopy. The task is a formidable one and criticism of any kind would be ungracious. We could have wished, however, that it might have been possible to make use of energy-level diagrams in presenting the data in suitable cases. A list of the elements dealt with may be of interest to those working in this subject. They are: silver, aluminium, argon, arsenic, gold, boron, barium, beryllium, bismuth, bromine, carbon, calcium, cadmium, cerium, chlorine, cobalt, chromium, cæsium, and copper.

While recognising that a work of this kind cannot be published cheaply, most English workers will probably feel that the price is formidable.
R. C. J.

The Annual Register: a Review of Public Events at Home and Abroad for the Year 1932. Edited by Dr. M. Epstein. Pp. xii + 318 + 180. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 30*s.* net.

THIS valuable summary of the history of the past year compresses into a few hundred pages the vicissitudes of a troubled period in most countries. There was much to record but the task has been accomplished within the customary space without the exclusion of any movement of importance. As usual, British, Imperial and foreign history occupy about two-thirds of the book. Then follow summaries of literature, art, drama, music, science, finance and law with an obituary and biographical notices. Into fourteen pages is condensed an outline of scientific advances during the year. Among the documents published *in extenso* in the volume are the summary of conclusions of the Imperial Economic Conference at Ottawa in July 1932, and the Note to the United States government on the War Debt in December last.

Introduction to Theoretical Seismology. By Rev. J. B. Macelwane and Rev. F. W. Sohon. Part 2: *Seismometry.* By Rev. F. W. Sohon. Pp. ix + 149. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 16*s.* 6*d.* net.

THIS useful book is the first account in English of the instrumental side of seismology since that of G. W. Walker. It proceeds by easy stages from the simple pendulum to the complications of modern seismographs, going so far as to explain the difficulties attendant on the second and third order terms in the vertical instruments. Methods of determining epicentres are described, but it is surprising to find no mention of Turner's direction-cosine method of determining epicentral distances.

Muscular Movements of Fishes*

By DR. J. GRAY, F.R.S.

IF a body is moving through water at a constant speed, the body must be constantly supplied with energy. In the case of a fish, the requisite energy is supplied by the muscles and is applied in such a way as to exert a backward thrust on the water, which compensates the resistance exerted by the water on the body of the moving fish.

As observed by the human eye, the motions of various types of fish appear to vary considerably from one species to another. At one extreme is the eel, which, during motion, is characterised by distinct waves of curvature which pass alternately down each side of the body from head to tail. At the other extreme is the mackerel or the trout, which appears to progress by means of transverse strokes of the expanded caudal fin. An examination of successive instantaneous photographs shows, however, that the nature of these two types of movement is essentially the same, for in all cases, waves of curvature pass along the body with increasing amplitude as the hind end of the fish is approached. The only significant differences between the eel and the mackerel are the relatively larger amplitude of the waves towards the anterior end of the eel, and the relatively longer body—with consequently longer length of wave—in the eel as compared with the mackerel. Both the nature and frequency of the waves of muscular curvature vary in different cases.

As recorded by the eye, the movements of a fish are almost invariably movements of one part of the body relative to another—we watch the waves of curvature passing backwards relative to the head of the eel, or we watch the tail of a mackerel sweeping from one side of the body to the other. From a propulsive point of view, however, we are more concerned with the motion of the body relative to the surrounding water, and in order to record such movements it is necessary to employ a camera, and to photograph the fish, against a clearly defined background, at known intervals of time. Observations of this type enable us to record the movements of each part of the body relative to other parts and relative to the surrounding medium.

Records have been made of a number of typical fish, but, owing to the well-defined nature of the muscular waves, attention may be first concentrated on a small glass eel (*Anguilla vulgaris*) which is approximately 7 cm. in length. It is found that each point on the animal's body is travelling forward through the water along a sinusoidal curve the 'pitch' or wave-length of which is the same for all points of the body (namely, 3·2 cm.) but the transverse amplitude of which becomes progressively greater as we select points lying farther away from the head. If we select two adjacent points on the body and plot out their movements relative to the background of the fish, it is seen that each sector of the body is moving with its leading surface inclined at an angle to its own path of motion. The photographic records also show that, relative to the head of the fish, each leading surface is always directed obliquely backwards except at the extreme positions of the displacement.

The leading surface of the fish has therefore two distinct properties: (1) it faces obliquely backwards relative to the head of the fish; and (2) it is moving at an angle to its own direction of motion. These two properties are responsible for the forward propulsion of the fish. So long as the leading surface is moving at an angle with its own path of motion, there will be a pressure exerted at right angles to the surface, and so long as the leading surface is directed obliquely backwards relative to the head of the fish, the pressure will be directed obliquely forwards. The forward component of this pressure tends to drive the fish forwards.

The principle is fundamentally the same as in a screw-propeller or in the blade of a sculling oar during the first part of its stroke. In the screw propeller the leading surfaces of the blades represent surfaces directed obliquely backwards relative to the ship and, when the ship is in motion, they are moving forward at an angle to their own path of motion. In the case of the fish, the propellant surfaces are moving in two dimensions instead of in three—and this is possible by virtue of the elasticity of the body, which enables the leading surface to be suitably reorientated at the end of each transverse cycle.

The surface of a screw and the leading surface of a fish's body resemble each other in that they are always exerting a pressure at right-angles to themselves, although, in the fish, the extent of this pressure varies at different points on the body and at different phases of each transverse movement. The waves which pass down the body of a fish also have their counterpart in the mechanical screw. If the pointed end of a household screw is held vertically downwards and the screw be rotated, it can be seen that the edges of the screw surface appear to move along the side of the screw in a direction which varies with the direction of rotation. If the screw is turned 'in' the ridges appear to move upwards; if the screw is turned 'out' the ridges appear to move downwards. If, however, the screw is free to move in a well-fitted nut, the ridges appear to be stationary when the screw is rotated in either direction. It can be shown fairly simply that the screw will only do work when the 'ridges' appear to move upwards or downwards at a greater rate than that at which the screw itself is moving in an opposite direction. The same facts can be summarised by saying that the screw will only exert a pressure when there is an 'angle of attack' between its leading surface and the direction of the latter's motion; within limits, the greater is this angle of attack the greater is the pressure exerted by the screw. So also in the eel, the surface of the body can only exert a forward thrust when the waves of muscular contraction pass backwards along the body at a greater rate than that at which the fish is moving forwards through the water. When a wave passes down the body of a fish at rest, the angle of attack is, at first, of maximum value and the thrust is correspondingly high—consequently the fish rapidly gathers speed until the angle of attack gives a thrust which is equal to the forces resisting the motion of the whole fish; during this period, there has been a steady reduction in the rate at which the muscular waves are travelling backwards relative to the environment. If the fish, having acquired a uniform speed, increases the velocity at which it transmits the waves along its body, then the angle of attack will again rise. A second period of acceleration of movement will occur until the angle of attack has again fallen to an equilibrium value. For any given speed of transmission of the waves along the body there must be a definite speed of forward propulsion which depends on the form of the fish's body. A series of waves passing down the body of a fish must therefore automatically travel at a greater speed than that at which they propel the fish forwards. Correspondingly, if the direction of the waves is reversed, the fish moves backwards—a phenomenon clearly seen in a large conger eel.

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* Friday evening discourse before the Royal Institution delivered on April 28.

We may conclude that the whole body of the eel is acting as a propeller by virtue of the fact that the leading surface is always inclined obliquely backwards relative to the head and at an angle to its own path of motion.

If we now consider the movements of a whiting or other typically pelagic fish, certain points of difference are obvious: (1) the length of the body, relative to its cross-section, is much less than in the case of the eel; (2) the hind end of the body tapers relatively abruptly and ends in an expanded caudal fin. When recorded photographically, however, the movements of the body are found to be of the same fundamental type as those of the eel, for in all cases waves of curvature pass alternately down each side of the fish.

In the whiting, the amplitude of these waves remains quite small until the posterior region of the tail is reached, where it increases more abruptly than in the case of the eel. The effect of these waves is such as to maintain the leading surface of the body inclined obliquely backwards relative to the head. A similar orientation is maintained by the leading surface of the caudal fin, and since the area of the fin is considerable, it is of interest to consider how far it plays an essential rôle as a propellant surface. It is well known that fish with badly lacerated caudal fins can swim actively and the observations of Breder show that amputation of the caudal fin of *Scardineus* does not markedly affect the speed of propulsion. This observation has been confirmed by the removal of the caudal fins of the rudd, the perch, and the whiting. For technical reasons it has not been possible to observe the effect of amputation of the caudal fin in fish moving at a high speed, but it seems fairly clear that the 'cruising' speed is not appreciably reduced.

At first sight, these facts suggest that the main propulsive surface of a whiting is provided by the body itself and that the surface of the caudal fin is relatively insignificant. An examination of the photographic records, however, shows that the removal of the caudal fin alters, in a significant manner, the movements of the fish. In the intact fish, we have seen that the leading surface of the body is always directed obliquely backwards. When the caudal fin has been removed, however, this is no longer the case, for the stump of the tail now swings about its base as a relatively rigid structure; as it moves from the extreme position of displacement towards the central position its leading surface is directed obliquely backwards, but as it moves from the central position towards the extreme position of displacement on the other side, the leading surface is directed obliquely forwards.

The difference between the movements of the intact fish and those of one from which the caudal fin has been removed is clearly due to the resistance which the tail fin offers to transverse movement. The fin represents a surface of high resistance lying posteriorly to the region of muscular contraction and it causes the intervening region of the body (which is flexible) to bend into an arc, with the convex surface towards the direction of motion; in other words, the fin causes the posterior region of the body to lag behind all those parts which lie between itself and the point of contraction so that each group of muscles, as it comes into play, is operating on a region of the body which is directed obliquely backwards relative to the head. The effect of the fin is exactly parallel to that produced by attaching a flat plate to the distal end of a steel wire and oscillating the proximal end of the wire through a small angle. Without a flat plate each part of the wire moves in practically the same phase as any other part—but when the plate is present the distal end of the wire lags behind the proximal end. A series of movements is set up which is strikingly similar to the normal movements of a fish's body; without the attached plate, the movements of the wire are comparable to those of a fish from which the tail fin has been removed.

At first sight, it seems strange that a fish can move forwards without a tail fin, for one might imagine that the propulsive effect produced when the tail is directed obliquely backwards would be exactly neutralised by the action of the tail when directed obliquely forwards during the second half of each stroke. It must be remembered, however, that so far we have been considering the movements of the tail relative to the head. When we examine the movements of the tail relative to the water, we see how the fish—without a caudal fin—can propel itself through the water. During the first half of the stroke, the tail is not only directed obliquely backwards but it also sweeps through the water, thereby generating a forward thrust, but at the moment it begins to face obliquely forwards, its motion through the water is checked, for it begins to move against the water which is flowing past the sides of the fish. The tail then begins to act as a rudder, and the position of the tail relative to the head is maintained by a movement of the head end of the fish through the water instead of by a movement of the tail. The two phases of each stroke are thus asymmetrical and the fish is able to progress through the water, although not in the smooth steady manner characteristic of the intact fish.

It is clear that by exerting a mechanical resistance to transverse movement through the water, the caudal fin of the whiting maintains the necessary phase difference between successive regions of the muscular body and tail, and thereby enables the whole of the energy of the muscular contractions to be expended in a smooth symmetrical manner. The question may be asked: Why can an eel or dogfish progress smoothly without the presence of a large caudal fin? The answer is that the function of the caudal fin of a whiting is, in the case of the eel or dogfish, carried out by means of the long flexible body itself. In exactly the same way, well-defined waves can be transmitted along a long flexible wire without the presence of a flat plate attached to the distal end. It is only when the wire is short that a flat plate is essential for maintaining an adequate phase difference between successive regions along its length.

Although the removal of the caudal fin does not substantially reduce the forward rate of movement, it is not legitimate to assume that the propulsive thrust from the fin is negligible in the intact animal, for it has been shown that amputation of the fin induces far-reaching changes in the movements of the remainder of the body relative to the surrounding water. A preliminary attempt to estimate the propulsive effect of the tail fin of the whiting was carried out as follows.

A series of vertical rods was so mounted in a metal frame that each rod moved harmonically with the amplitude characteristic of different levels of a whiting's body; the ends of the rods were then inserted into the body of a dead whiting. By rotating a handle, the body of the fish was forced to transmit a series of waves identical with those seen in the normal living fish, and for a given frequency of waves the velocity of the current produced in a tank of water was determined. The caudal fin was then removed and the current again measured for the same frequency of movement. Although the method of measuring the current was not free from criticism, the results suggest that approximately 40 per cent of the propulsive thrust from a whiting is derived from the caudal fin.

It is of interest to note that just as the propulsive thrust represents the forward component of the pressure of the fin against the water, so the transverse component of this pressure plays its part in adding to the resistance offered by the fin to transverse movements, so that the biological functions of the fin are very clearly linked together, just as is the case with the surface of the body itself. If the area of the body surface is large in comparison to that of the fin, the rôle of the fin may be relatively insignificant as in the eel, but in the pelagic type of fish the posterior region of the muscular tail is comparatively narrow and tends to present a convex surface to the water, whereas the tail fin is relatively large and presents a flat surface to the water. In the latter case the fin probably plays an increasingly important rôle as a propeller, just as it plays an increasingly important rôle by virtue of its resistance. Until a very accurate method is devised for measuring the currents produced by various types of tail fin, it is dangerous to speculate on the effect produced by variations in the shape of the caudal fin.

So far, we have only considered the motion of fish which are swimming in a straight line, but one of the most striking features of a moving fish is its ability to change the direction of its motion. In some cases such changes are effected by movements of the paired fins, but the rapid changes so characteristic of pelagic types are effected by the muscles of the body itself. In all cases a change in the direction of motion has been found to be due to the propagation of a muscular wave along one side of the body, and the fish always turns towards the side along which the wave is travelling. These waves are most conspicuous in the case of the eel, but they can be recorded photographically in other types. We may take as an extreme example the goldfish. As observed by the eye, a goldfish appears to turn by a rapid flexure of the tail towards one side. Actually, however, the tail remains practically stationary in the water until the head end of the fish has almost if not completely finished its turning movement—after which the tail swings through the water towards the opposite side to which the animal turns.

The examination of a number of photographic records has shown that the turning movement of such fish is divisible into two parts: (1) the head moves through the water by using the tail fin as a relatively stationary pivot; (2) the tail moves through the water using the head as a stationary pivot. The effect of the tail fin during the first phase of the movement is simply an exaggeration of its effect during normal swimming, namely, to delay the movements of the hind end of the body whilst movements are occurring farther towards the head. As one might expect, the amputation of the caudal fin exerts a very far-reaching effect on the turning powers of the fish. A normal goldfish can turn through nearly 90° by one flexure of the body—but if the caudal fin be removed, the same turn can only be effected by several flexures. With or without a caudal fin the amplitude of the muscular contractions is practically the same, but in the absence of the caudal fin a muscular contraction on the left side of the body causes both head and tail to move simultaneously to the left of the original axis—in the presence of a caudal fin only the head moves whereas the tail remains stationary. Since the curvature of the body is the same in the two cases, it follows that the angular displacement of the head through the water is greatly reduced by the amputation of the fin. The maximum change in the direction of the fish cannot exceed the initial movement of the head, and this can only be maximal when the posterior end of the body remains undisplaced. Clearly the function of the tail fin is to enable the hind end of the body to act as a fulcrum on which the head turns. As in normal motion, the rôle of the caudal fin is, in the eel or dogfish, carried out by the long flexible body itself.

We have now seen that the caudal fin exerts two forces on a moving fish : (1) it tends to inhibit the transverse movements of the hind end of the body ; (2) it exerts a fraction of the forward propulsive thrust. Both these forces are derived from the pressure exerted on the water at right angles to the surface of the fin. The 'resistant' force is the transverse component of this pressure, and the propulsive thrust is the forward component. The absolute and relative values of these forces remain to be determined.

So far, we have considered the movements of the body without reference to the actual process of contraction of the muscles. The muscle fibres of the trunk and tail all run parallel to the long axis of the body, and they are so controlled that when a fibre on one side of the body is fully contracted, its opposite neighbour on the other side of the body is fully relaxed. Further, it is clear that the fibres along one side of the body do not contract simultaneously but in sequence, beginning with those nearest to the anterior end of the body. Each group of fibres is supplied by motor nerves, and it has been suggested that a muscular wave is the result of the passage of a nervous disturbance down one side of the spinal cord, firing off each group of fibres as it goes. It is difficult, on this view, to account for the very variable speed of transmission of the muscular waves.

There are, on the other hand, a number of facts which suggest that when the muscles (lying on one side of the base of the muscular tail) contract, their energy can be transmitted mechanically along the body of the fish just as such energy can be transmitted along the length of an elastic wire. The energy is transmitted in the form of tension by the stretched skin and muscles of the leading side of the body. If the muscles lying nearer to the tip of the tail are to be usefully employed, they must liberate their energy in phase with that of the mechanical wave. When the mechanical wave reaches any given point it first tends to store energy at that point by bending the body into a convex curve—and then this energy is afterwards liberated as the tension is released. If, therefore, the muscles at any point are to supplement this mechanical cycle, it follows that they must begin to contract at the moment when a similar shortening process is being induced by the mechanical wave. This would occur if the stimulus to contract were automatically induced by a stretching of the muscle itself. Such a proprioceptive mechanism is well defined among other vertebrate types and its existence in fish would account for many otherwise unrelated facts.

Low Auroras

IT is frequently asserted (*a*) that the aurora occasionally descends to the earth's surface so that it can be seen between the observer and relatively near terrestrial objects, and (*b*) that not infrequently unmistakable sounds accompany auroral displays. Several writers have collected reports from residents in regions where the aurora occurs and a large mass of evidence for the reality of low auroras and sounds accompanying auroral display has been accumulated. In NATURE for March 7, 1931, Prof. S. Chapman reviewed one such collection of reports and expressed his opinion that "These letters make it difficult to deny that auroræ occur, very rarely, quite near the earth, and are sometimes accompanied by noises".

In an article which has just been published in the *Quarterly Journal of the Royal Meteorological Society* (vol. 59, p. 249), Dr. G. C. Simpson discusses the whole problem of low auroras and auroral sounds and comes to the conclusion that "the evidence for low auroras is extremely weak and that when one weighs that evidence against the positive information we have about the nature and position of the aurora one is justified in denying that auroras have ever been observed below a height of 80 km." With regard to sounds, Dr. Simpson says that he is not prepared to deny the possibility that there may be some form of objective sound associated with the aurora, but he very much doubts it.

Dr. Simpson uses three main arguments against the reality of low auroras. In the first argument he points out that we now know that the chief spectroscopic line of the light of the aurora is due to a metastable state of atomic oxygen. This condition of oxygen is only possible when the pressure is very low, and trigonometrical measurements have proved that the height of the ordinary aurora is more than 80 km., where the pressure is sufficiently low. If now an auroral streamer passes from this height to the earth's surface where the pressure is too high for atomic oxygen to exist, a second physical process must come into action, and this process, whatever it may be, would have to come into action in exactly the same proportion as the effect of the first process decreased, for the streamer must remain a streamer, the intensity of the light must not be radically changed and there must be no marked change in its colour. That there should be two such processes is very unlikely on general principles. No suggestion has been made regarding this second process except that it may be due to a high electrical field in the lower atmosphere produced by the aurora itself; but instrumental observations have shown that such high electrical fields do not accompany auroras. Further, no electrostatic field in air at atmospheric pressure can be made in the laboratory to give a glow throughout an extensive region; the highest field attainable only produces localised brush discharges or actual disruptive sparks which are not remotely like the glow of an aurora.

The second argument is based on the principles of perspective. Practically all the observers report that the low auroras look exactly like the normal auroras: they move in the same way, they appear both as streamers and as diffuse glows, they are of the same colour. No difference in breadth of streamer, rapidity of motion, intensity of light or colour is remarked upon. In fact, it is because the low aurora looks like and behaves like the high aurora that their identity is so strongly affirmed. All this is contrary to the laws of perspective. It is generally admitted that the normal aurora occurs in the upper atmosphere at a height of at least 80 km., so that the average distance from the observer must be something like a hundred miles. If such an aurora were suddenly transferred to the neighbourhood of the observer, it certainly would not look exactly the same as it did when it was a hundred miles away. Thus the opinions so strongly held by the observers that they have seen auroras at ground level exactly like the ordinary high auroras is the strongest evidence that could possibly be given against their conclusions.

The third line of attack is to show that all the reported cases of low aurora are optical illusions. The darkness necessary for the aurora to be seen at all makes illusions easy, especially if there is a moon, for moonlight illuminates clouds and snow ridges with an intensity comparable with that of an aurora. Auroras seen between gaps in clouds or between trees when the whole landscape is dark look as though they are in front of the clouds or trees. The aurora appears in the sky simply as light masses and the observer has absolutely no criteria by which to determine the distance; but with ordinary lights their brightness and the sharpness with which they can be seen are the two factors on which judgment of distance is chiefly based. The aurora varies greatly in intensity and without exception the most brilliant auroras consist of rapidly moving, very sharply defined streamers, either in the form of curtains with clear-cut 'folds' or as long narrow shafts with relatively sharp edges. It is therefore not surprising that these auroras appear to be much nearer than those which appear as irregular ill-defined arches and clouds. Many so-called low auroras are simply parts of haloes round the moon or are due to the illumination of fog banks or snow surfaces in bright moonlight.

In concluding his article, Dr. Simpson says that it is not possible to bring the same type of argument against the sound of an aurora as against its low position; but naturally, if the aurora is confined to the high atmosphere, sounds are unlikely. He considers that the observed sounds are psychological, being due to the natural association of sound with the rapid movement of the streamers and the waving of the 'draperies'.

Obituary

MR. CHARLES S. CARTER

THE death of Charles S. Carter, curator of the Museum of the Louth Naturalists', Antiquarian and Literary Society, and president of the Lincolnshire Naturalists Union in 1928 and 1929, at the age of sixty-seven, took place at Louth (Lincs) on April 14. In addition to being curator of the Museum, Mr. Carter was joint honorary secretary of the Society and conchological secretary of the Lincolnshire Naturalists Union, as well as a member of the Lincolnshire Archæological Society.

Mr. Carter belonged to the distinguished band of self-taught amateur scientific investigators, to which local archæology and natural history in Great Britain are so deeply indebted. Not only by their individual labours, but also by the enthusiasm with which they have inspired others, they have kept alive a tradition of local interest and research, in which Great Britain stands almost, if not quite, alone.

Born in 1866 at East Torrington, Mr. Carter was educated for a short time at elementary schools, and then began work in the fields at the age of nine. He was later apprenticed to a cordwainer and worked as a cobbler for the remainder of his life. His interest in archæology and natural history began when he took up his residence in Hampshire, under the influence of Dr. S. Andrews of Basingstoke, with whom he traced the Roman road through Pamber Forest and was a close observer of the excavation of the neighbouring Roman city of Silchester. On removing to Kent, he became associated with the late Benjamin Harrison and Dr. Lewis Abbott between the years 1893–1896 in the collection of eoliths. The period of his greatest activity, however, began when he returned to Louth in 1898. Among other achievements, he discovered the neolithic settlements at Tathwell and Kelstern, recorded several botanical and entomological species for the first time in the county, and found a chalk fossil, *Tylopora lorea*, Lang, which was new to science. Mr. Carter was a frequent contributor to the *Naturalist* and the *Proceedings* of the Lincolnshire Naturalists Union.

DR. JOSEF BAUDIŠ

THE death of Dr. Josef Baudiš, professor of Celtic and comparative philology in the University of Bratislava, on May 4 is announced. Dr. Baudiš was widely known as an authority on the Celtic languages and literatures, more particularly of Erse. In addition to academic studies at the Universities of Prague and Heidelberg, he visited Wales and Ireland annually for purposes of linguistic investigation. His published works include "A Grammar of Early Welsh" (1914), "Structure of the Indo-European Languages", a translation of Czech folk-tales (1917) and a large number of contributions to learned periodicals on early Erse and the Irish saga. He was for a time joint secretary of the Philological Society of London, and one of the founders of *Philologica*.

THE Rev. Frederick L. Odenbach, S.J., for the past forty years meteorologist and seismologist at John Carroll University, Cleveland, Ohio, died on March 15 at the age of seventy-five years. It was through Father Odenbach's influence and initiative that seismographic equipment was installed and stations were organised at fifteen Jesuit colleges and universities in the United States and Canada during the years 1909–12.

We regret to announce the following deaths:—

Mrs. Zelia Nuttall, honorary special assistant at the Peabody Museum of Harvard University and honorary professor of archæology at the National Museum of Mexico, known especially for her work on the ethnology, etc., of Mexico and Central America, on April 12, aged seventy-four years.

Prof. J. G. Porter, professor of astronomy at the University of Cincinnati and director of the Cincinnati Observatory, known for his work on the proper motion of stars, and comet orbits, on April 15, aged eighty-one years.

Mr. A. B. Seymour, since 1886 assistant in the Cryptogamic Herbarium at Harvard University, an authority on parasitic fungi, on March 29, aged seventy-four years.

Col. J. C. B. Statham, C.B.E., C.M.G., author of "Through Angola", a well-known traveller and naturalist in West Africa, on April 29, aged sixty years.

News and Views

King's Birthday Honours

THE King's birthday honours list contains the names of the following scientific workers and others associated with scientific work: *K.T.:* The Earl of Elgin and Kincardine, chairman of the Carnegie United Kingdom Trust. *K.C.B.:* Dr. G. F. Hill, director and principal librarian of the British Museum. *K.C.M.G.:* Sir James Currie, chairman of the governing body of the Imperial College of Tropical Agriculture, Trinidad, and director of the Empire Cotton Growing Corporation. *Knights Bachelor:* Mr. H. T. D. Acland, vice-president of the Dominion Council of the Australian College of Surgeons, Dominion of New Zealand; Mr. A. W. G. Bagshawe, director of the Bureau of Hygiene and Tropical Diseases; Dr. G. C. Clayton, president of the Institute of Chemistry and a director of Imperial Chemical Industries, Ltd.; Dr. R. H. P. Crawfurd, consulting physician, King's College Hospital, registrar of the Royal College of Physicians, London; Dr. Kedar Nath Das, principal of the Carmichael Medical College, Calcutta, Bengal; Dr. W. S. Duke-Elder, ophthalmic surgeon, St. George's Hospital, London; Dr. M. O. Forster, lately director of the Indian Institute of Science, Bangalore; Dr. H. Stuart-Jones, principal of the University College of Wales, Aberystwyth; Col. R. McCarrison, director of Nutritional Research, Indian Research Fund Association, India; Mr. R. S. Pearson, director of the Forest Products Research Laboratory, Department of Scientific and Industrial Research. *C.B.:* Col. W. H. Leonard, late Indian Medical Service; Dr. A. Landsborough Thomson, assistant secretary of the Medical Research Council. *C.M.G.:* Mr. J. L. Gilks, director of medical and sanitary services, Kenya; Mr. J. Strachan, general manager and chief engineer, Federated Malay States Railways. *C.I.E.:* Mr. H. P. Thomas, chief engineer, Hydro-Electric Department, Punjab; Mr. J. de Graaff Hunter, director of the Geodetic Branch of the Survey of India; Lieut.-Col. W. L. Harnett, professor of surgery, Medical College, Calcutta, and surgeon to the College Hospital, Bengal; Mr. J. N. Duggan, professor of ophthalmic medicine and surgery, Grant Medical College, and superintendent, C. J. Ophthalmic Hospital, Bombay. *C.B.E.:* Mr. H. A. Ballou, Commissioner of Agriculture for the West Indies and professor of entomology in the Imperial College of Tropical Agriculture, Trinidad; Mr. E. L. Mitchell, assistant secretary, Ministry of Agriculture and Fisheries; Mr. V. E. Pullin, director of radiological research, Research Department, Royal Arsenal, Woolwich; Maj. C. E. Williams, chief inspecting engineer, Office of the Crown Agents for the Colonies. *O.B.E.:* Mr. A. J. King, executive engineer, personal assistant to the Chief Engineer to the Government of Bengal; Mr. C. M. Pitt, surveyor and engineer, Public Works Department, State of Tasmania. *M.B.E.:* Mr. E. W. Dunn, assistant engineer, Assam; Mr. W. N. Winn, botanist, Royal Botanic Gardens, Kew. *Hon. M.B.E.:* Ragheb Effendi Mohammad, sub-inspector of agriculture, Department of Agriculture and Forests, Palestine. *I.S.O.:* Mr. J. W. Atherton, superintending cartographer and assistant superintendent of charts, hydrographic Department, Admiralty; Mr. J. L. Frood, superintending inspector, Diseases of Animals Division, Ministry of Agriculture and Fisheries; Mr. P. H.

Grimshaw, keeper of the Natural History Department, Royal Scottish Museum; Mr. J. Hedley, staff engineer, General Post Office; Dr. C. F. Lassalle, deputy surgeon-general and medical inspector of Health, Colony of Trinidad and Tobago; Mr. W. McAuslan, engineer surveyor-in-chief, Board of Trade.

France and Great Britain in Africa

M. ALBERT SARRAUT, Ministre des Colonies of France, as chief guest at the African Society's dinner on May 23, was both apt and illuminating in the distinctions which he drew between French and British ideals and methods in the administration of native affairs in Africa. The whole of M. Sarraut's speech was inspired with a deep sense of the responsibility which lies upon the two nations—a responsibility "to protect and improve the destiny of the backward races, weighing more heavily than ever on our shoulders". He pointed out that "we are perhaps on the threshold of new times, in which the load that we bear will grow heavier". Even were there no stronger reason, it was the logical consequence of this view that M. Sarraut should enter on a comparison of the two systems of administration in their attitude towards this great problem. He displayed both knowledge and justice in his comparison. While he claimed for France a nearer approach to the life of the native, he admitted for Great Britain a greater regard for tradition. "You," he said, "listen especially to the prudent, but rather cold counsel of experience. We warm our actions in the flame of apostleship. You, in sum, wish the races to place themselves in a condition to make their own happiness; we wish ourselves to make their happiness urgently and with authority."

IT was evident that M. Sarraut had here in mind, more particularly, the methods of 'indirect rule' of Lord Lugard, of whom, indeed, he spoke most warmly. It is this which gives his speech its greatest significance for those whose interests lie in the application of scientific study to the problems of administration. For he went on to point out, what has indeed been apparent for some time in modifications which circumstances have brought about in French methods of administration, that France and Great Britain, with an identical object in view, are "bending towards a meeting point". With this as his justification he appealed for collaboration—an appeal addressed to all colonising nations. In connexion with M. Sarraud's remarks on Great Britain's regard for tradition and the convergence in method of the two systems of administration, it may not be inappropriate to direct attention to a communication which appears in a recent issue of *Africa* (vol. 6, pt. 2) referring to an expedition of M. Henri Labouret, of the École Coloniale, to French West Africa for the purpose of studying the social and economic organisation and the land system of the natives. Not only did this expedition have the official support of the Ministry of Education and the Minister for the Colonies, but also M. Labouret was accompanied by a graduate of the École with a grant from the Rockefeller Foundation to enable him to become acquainted with conditions in the field. This was in furtherance the policy of M. Labouret, himself, it will be remembered, a former Colonial Minister, of introducing trained ethnographers into the French colonial administrative service.

Scientific Problems of the Pacific

A NOTEWORTHY demonstration of the possibilities of long distance wire and radio telephony was given on June 5, when Lord Rutherford, speaking as the representative of science in Great Britain, delivered an address to the Fifth Pacific Science Congress assembled at Vancouver. Lord Rutherford, in the brief space of some eight minutes, touched on a number of problems closely identified with the work of the Congress. He reminded his audience that the investigation of their region was inaugurated by the British Government and the Royal Society more than a century and a half ago, when they sent Capt. Cook on his first voyage of discovery in the Pacific, accompanied by Sir Joseph Banks and other scientific observers. Lord Rutherford referred to the loss of the famous non-magnetic ship, the *Carnegie*, at Samoa, and to the recent investigations carried out in the Antarctic by the "Discovery" Committee and by the Great Barrier Reef Expedition, off the coast of Queensland. Speaking of notable advances in our knowledge of the transmission of radio waves, which have resulted in the discovery of at least two distinct reflecting layers in the upper atmosphere, he congratulated the Australian Radio Research Board on the valuable contributions its workers have made to our knowledge of this question. He also stressed the importance of the problems of the depopulation of the islands of the Pacific, and of the preservation of the fauna and flora of the region. Lord Rutherford congratulated the Canadian organisers of the Congress on their courage and vision in arranging the meeting in spite of economic conditions, and said: "it is of good augury that representatives of all the countries bordering on the Pacific Ocean have met together in a spirit of friendliness and co-operation to discuss the multifarious scientific problems connected with the Pacific. Science is international, and I trust will ever remain so." After his address, Lord Rutherford had a conversation with Dr. H. M. Tory, president of the Congress, Prof. A. S. Eve, and others.

Legal Size Limits and their Effect upon Fisheries

IN California, more than twenty years ago, when the crab fishery was declining, an investigation carried out by F. W. Weymouth, of Stanford University, showed that the then minimum size limit of six inches was too low, since it permitted the destruction of male crabs before they had a chance to breed. On the evidence put before it, the Legislature decided to raise the limit at which the commercial crab might be taken, to seven inches. The result of so small a change has been remarkable. A few years after the passing of the new regulation, when the first crop of crabs under its protection had reached the seven-inch size, the production of the fishery suddenly doubled, and since then the catch has gone on increasing until now the fishery produces 75,000 dozen crabs more than it did before the law was changed, an increase worth 185,000 dollars to the fishermen (N. B. Scofield in *California Fish and Game*, 1932, p. 260). Yet originally they opposed the change, saying that already at six inches the size limit was too high, and that declining production could be stayed only by permitting the capture of smaller individuals through the reduction of the six-inch limit. Once more, scientifically ascertained facts have triumphed over opinion and so-called experience.

W. E. Dixon Memorials

Two memorials to the life and work of the late Prof. W. E. Dixon, who was reader in pharmacology in the University of Cambridge until his sudden death on August 16, 1931 (see NATURE, 128, 401, Sept. 5, 1931) are being established. The first, already in being, is due to the action of the British Medical Association, which has named one of its most valuable research scholarships the "W. E. Dixon Memorial Scholarship". The second is to take the form of a lectureship. Certain of Dr. Dixon's friends, under the chairmanship of Sir William Willcox, opened in 1931 a fund for this purpose. The final meeting of subscribers to this fund was held at the house of the Royal Society of Medicine on June 1. This meeting resolved that the money collected (£700) should be used to establish a "W. E. Dixon Memorial Lecture" which should be delivered biennially or triennially, on some subject of pharmacological or therapeutic interest. The Royal Society of Medicine was invited to undertake the trusteeship of the fund. The response to the appeal which was issued has been extraordinarily wide. Present and past students, colleagues, former colleagues, and personal friends in Great Britain, the United States, and on the Continent, have all contributed. In addition, donations have been sent from representatives of commercial firms, and from several learned societies, both at home and abroad. This response shows how wide was Dixon's influence, and how warmly his qualities were appreciated.

Composition of the Stars

ON June 1 the annual Halley lecture at the University of Oxford was delivered by Prof. Henry Norris Russell, professor of astronomy and director of the University Observatory, Princeton, on the subject of the "Composition of the Stars". He remarked that the statement of Comte about a century ago, that no human being could ever learn anything of the composition of the stars, was speedily invalidated by the detection of various elements in the sun by the employment of spectrum analysis. From the adaptation by Huggins of suitable spectroscopes, it was soon ascertained that the same substances as occurred in the sun were also to be found in the stars. It was next made clear that the stars fell into natural classes, white, yellow and red, with intergrades. The stellar conditions of extreme heat made it possible to investigate the properties of matter at their simplest. The intensities of the lines of the spectrum were almost as important as their position. Iron was shown to be abundant in the sun, copper next, silver comparatively rare. Fifty-eight elements are now known in the sun; improvements in apparatus will no doubt disclose others. Sir Norman Lockyer was right in surmising that atoms themselves are structural, they disintegrate in white stars; he was again right in holding that the width of a line is proportional to the number of atoms producing it. In the interior of stars, the atoms of light elements are disintegrated by the collision of protons with the nuclei. There is an unsearchable part of the solar spectrum; the lines of the missing elements may occur within it. At the conclusion of the lecture, diagrams were shown which gave the number of atoms actually concerned in different kinds of stars.

Artificial Transmutation of the Elements

ON June 2 at Oxford, under the auspices of the Junior Scientific Club, the annual Boyle lecture was delivered by Lord Rutherford, who took as his subject the "Artificial Transmutation of the Elements". He described the pioneer achievement of Messrs. Cockcroft and Walton at the Cavendish Laboratory in applying the high-voltage method of generating fast streams of protons for producing atomic transformation, and detailed recent developments of method by which it was possible to obtain still greater results at a lower voltage. Further modifications had led to conclusions of high interest, and the new type of projectile now in use will no doubt result in extending the knowledge of types of possible transformation. It was probable that further assaults would be made on the stability of the nucleus, and there was already evidence of the appearance of a positively charged particle of mass comparable with that of the negative electron.

Constitution and Temperament in Man

IN *Scientia*, 53, 4, K. H. R. Edwards outlines the chief lines of approach to the study of the relationship between constitution and temperament, namely, the genetic, the teleological, the physiological, and the psychopathological. He realises that such differentiations are of descriptive rather than practical utility. He discusses the data relevant to the problem as presented by Bartlett, McDougall, Kretschmer, Pavlov, and Jaensch, and, perhaps somewhat optimistically, concludes that in the near future the advances in physiology, psychiatry and psychology will solve the problem. Discussions on temperament are complicated by the vagueness of writers as to the meaning of the word, coupled with the fact that popularly it is used for emotional instability, so that a well-balanced person would not be accredited with any temperament. The concept arose out of the observation that individuals differ in susceptibility to disease, and the hypothesis that this was due to some difference in physiological make-up (crasis, temperamentum, complexion) is at least as old as Hippocrates, although generally known in the form given to it by Galen. It is therefore a legitimate problem to investigate the truth of this hypothesis, and a survey of the literature shows that this has motivated many 'arm-chair' theories and a little experimental work. Physicians also observed that variation in disease susceptibility seemed to be linked with structural differences and psychological differences, and this presents another problem. The observed psychological differences are for the most part emotional in character. We thus have three variables, each very complicated, and for each we need measures. With the passing of time, emphasis has been placed on the psychological differences, but very often one of the old hypotheses is implicit.

Royal Cornwall Polytechnic Society

INCLUDED in the ninety-ninth annual report of the Royal Cornwall Polytechnic Society is an account of the annual meeting held at Falmouth in February 1932. On that occasion the president remarked that he looked back with pride on the very good work that the Society had done since its institution. "It has for 99 years been fostering useful crafts, promoting utilitarian arts, and promulgating the logic and tenets of science, all in the interests of the Cornish industries." The principal event during the preceding year had been the renovation and adaptation of the premises of the Society for receiving the Falmouth Museum, the control of which had been transferred to the Society from the Town Council. The renovations had cost about £1,450. Together with the usual information about membership and finance, the report contains accounts of the summer meeting and seven original contributions. Among these is a short but useful account of the development of explosives and a sketch of the life and work of the Cornish engineer Michael Loam (1797–1871) the inventor of the man engine. Before the days of steam winding engines, miners generally ascended and descended the shafts by ladders, a practice which proved very injurious to their health. At the first meeting of the Society premiums were offered for some improvement on the existing methods and in 1838 a sum of £500 was offered for the application of machinery to facilitate the ascent and descent. Through these offers Loam was led to the invention of the man engine consisting of rods fitted with platforms, which were raised and lowered several feet at a time by an engine. There were fixed platforms in the shaft and men ascended or descended by stepping alternately on to a fixed platform and then a moving platform. The same plan was in use in Germany.

The Pepys Tercentenary

IN commemoration of the tercentenary of the birth of Samuel Pepys, which fell on February 23, a lecture was delivered by Mr. Edwin Chappell, at Clothworkers' Hall, Mincing Lane, London, on that date, recalling the primary circumstances of Pepys's career, these being brought into pleasant and effective remembrance by means of a series of one hundred and forty lantern slides. The lecture was published in the *Mariner's Mirror*, vol. 19, No. 2, April 1933. Pepys was Master of the Clothworkers' Company in 1677, and thirty-six years ago a lecture on Pepys was given in its Hall by Mr. H. B. Wheatley. Since then much valuable Pepysian literature has been issued, and Mr. Chappell himself has made a close study of the subject. We learn that the name Pepys may be pronounced, without criticism, as if written 'Peppis'. The full story of Pepys's association with the pioneer leaders in philosophical inquiries of his period remains to be written ; but it would not be advisable to attach special personal significance to Pepys's imprimatur on the title page of Newton's "Principia" ; it was the outcome of a formal request made to Pepys to license the book, and no more. Some attention was given in the lecture to contemporary portraits of Pepys. Kneller's canvas, which hangs in the rooms of the Royal Society, was Pepys's own gift, made whilst president, and it has never left the Society's keeping. If, as Mr. Chappell remarks, "it seems to be accepted that this portrait is a copy", then Pepys's sense of prestige, and the understanding of his colleagues (one of them Evelyn), are called in question.

Dangers of Very High Voltages

THE Institute of Fire Engineers has recently carried out experiments at Croydon on an overhead wire carrying current at 132,000 volts. A jet of water was projected against this wire at a distance of about thirty feet by means of a fire hose, and pressures of about fifty volts were measured between the nozzle and earth. The fireman said that only a prickly sensation was felt in his hands. An account of the experiments is given in the *Electrical Times* of May 25. In an editorial comment it is pointed out that it is not to be concluded from these experiments that playing a hose on high tension wires is safe. Nothing serious should happen to the man who operates the hose at earth potential, but if a jet of falling water in contact with the wire touched a bystander whose shoes happened to be wet, it might easily kill him. A recent law case in the Leeds County Court illustrates the dangers that arise when any conductor, even a bad conductor, touches a grid main. The mast of a barge being towed on the canal between Goole and Barnsley in Yorkshire touched the grid overhead line. The bargee, who was on the towpath at the time, heard a scream. Running back, he saw all the barge ablaze and his son lying on his back "as if he were dead". All the iron of the mast and the deck was burned and twisted. The chains became liquid and poured about like water and the mast fell down. His son had to go to hospital and the barge was laid up after the accident for six months. As the high tension wire had been strung across the canal at the prescribed height, the bargee got no damages as it was a case of "contributory negligence".

Electrification of an Ice Factory

THE Grimsby Ice Company has now the largest ice factory in the world. The trawlers of Grimsby fish in the North Sea and off the west coast of Greenland. All the six hundred trawlers take supplies of ice when they set off for the fishing grounds, each boat taking about 15 tons when going to fish in the North Sea and four times as much when fishing in Icelandic waters. In the *Metropolitan-Vickers Gazette* for March and April, J. H. Lamb gives an interesting account of the electrification of the factory. The plant is capable of turning out 1,200 tons of crushed ice a day and delivering it into the holds of the fishing vessels by means of a fleet of motor lorries. Before reconstruction, the plant was driven by ponderous slow-speed engines. It has now been replaced by electrically driven compressors and all the auxiliary equipment has been completely electrified. The refrigerating medium is ammonia and the ammonia gas is raised in the compressors to a pressure of between 100 lb. and 180 lb. per sq. in. It is next cooled and liquified by passing through a condenser. The liquid then passes to the refrigerating plant in tubes surrounded by brine. The liquid expanding to its gaseous form absorbs heat from the brine which is cooled below 0° C. The cold brine is circulated in a large tank containing the cans which hold the pure water to be frozen. The four compressors are driven by four motors each of 600 horse power. These are supplied with electric power by the Grimsby Corporation, through a transmission line at 6,300 volts. The Ice Company is developing a new process of freezing which it is hoped will popularise frozen fish. Complaints have been made that frozen fish are 'soft' or 'mushy' when thawed. By rapidly freezing them the water between the flakes of the fish does not crystallise and when thawed it is stated that the fish is just as firm and white as fresh fish.

Progress at the Indian Institute of Science, Bangalore

THE April number of *Electrotechnics*, the journal of the Electrical Engineering Society of the Indian Institute of Science at Bangalore, proves that rapid progress is being made in developing its activities. It has been decided to instal in the Electrical Department a radio frequency standard which will enable measurements to be carried out with the highest accuracy over a range extending from 10 to 24,000 kilocycles per second. The Government of India will recognise the Institute's certificates. It is hoped that this will prove the first step towards the establishment of a National Physical Laboratory of India. An obituary notice of the late Dr. Alfred Hay, who was appointed to the chair of electrical technology at the Institute in 1908, appears in this issue. Many of his students have done good work in electrical research. He was sadly missed by them when he left for England in 1923. He died in Cyprus in 1932. He was succeeded by Prof. J. K. Catterson-Smith, who is now Siemens professor of electrical technology at King's College, London. He did excellent work in developing radio research at Bangalore. Sir C. V. Raman became director of the Institute in succession to Dr. M. O. Forster, whose well-merited knighthood announced among the King's birthday honours will give particular pleasure to his friends. An interesting account is given of the Uhl River hydro-electric scheme. The combined output of the power stations will be 150,000 kilowatts. From an article by C. B. Sethna, director of the Bombay broadcasting service, on the progress of broadcasting in India, it appears that Calcutta, Bombay and Madras have now a regular broadcasting service. What is wanted seems to be a few high-power broadcasting stations at the centres of culture of the important linguistic areas of India.

Exchange of Goods during Economic Depression

REVERSIONS to simpler types of economic organisation are not uncommon in times of economic stress, and an interesting example is provided by the development of the exchange of goods and services by barter in the United States during the present economic depression. In 1931 a small exchange was opened in Salt Lake City to facilitate the barter of unemployed labour for surplus farm produce. Since then, the movement has spread rapidly to many parts of the country and now covers a wide range of trades and professions. A National Development Association was formed to organise the exchanges, and in July 1932 this body introduced a medium of exchange in the form of paper tokens known as 'scrip'. This 'scrip' represents to the holder the value of the produce or services he has provided and can be exchanged for an equal value of other produce, being readily accepted by traders, shops and theatres. The issue of 'scrip' is, however, far from being an innovation in the United States, and recently Mr. T. T. Belote, curator of history in the Smithsonian Institution, arranged an interesting exhibition of earlier examples. During the decade 1832–42, numerous bank failures led to much money being withdrawn from circulation, and to meet the monetary stringency a large number of so-called 'hard-time tokens' were issued. Some of these bore laudatory or satirical legends referring to the financial policies of Jackson or Van Buren. In the same period, many commercial firms issued a kind of token money known as 'store cards'. Up to the Civil War, paper scrip issued by banks and private firms of almost every imaginable character circulated extensively. Some of it was well-drawn and finely engraved, but so rapidly did many of the issues deteriorate in value that they came to be known as 'skin plasters'.

B.D.H. Products

WE have received from the British Drug Houses Ltd., London, N.1, leaflets describing the nature and uses of certain of their products. 'Spironine', a stable elixir, contains in each fluid drachm 3 grains of di-iodo-caffeine hydroiodide together with the soluble constituents of 7½ grains of coffee. It is recommended for the relief of asthma during the intermittent paroxysms. It should be given at the onset of an attack, its effect being immediate. By checking the paroxysms it prevents the development of such chronic conditions as emphysema and bronchitis. Another drug of great value in the treatment of asthma is 'Ephedrine', which also finds a place in the treatment of hay fever and whooping cough. Ephedrine B.D.H. is issued in tablets and in solution in ampoules, and as an elixir, an inhalant, a throat-spray and a nasal jelly. 'Acriflavine B.D.' is a useful antiseptic for the treatment of wounds and local septic conditions. It can also be administered by mouth (as neutral acriflavine or euflavine in enteric coated tablets) or by intravenous injection. A new edition of the firm's vitamin booklet has also been prepared. It describes the uses in general practice of 'Radiostoleum' (vitamins A and D concentrate), 'Radio-Malt' (containing vitamins A, B_1, B_2, and D), 'Radiostol' (vitamin D) and 'Avoleum' (vitamin A). 'Radiostoleum' liquid is standardised to a 'blue' value of 500 by the Carr-Price test and contains 3,000 international units of vitamin D (calciferol) per gram. The capsules have a 'blue' value of 1,000 and each contains 1,200 vitamin D units. It is recommended as a preventive against infection and also in the prophylactic and curative treatment of rickets and osteomalacia and dental caries. 'Radiostol' solution is prepared from pure crystalline calciferol. It is standardised to contain 3,000 vitamin D units per gram (B.P., 1932). 'Avoleum' is standardised to a 'blue' value of 1,000.

Pathology and Bacteriology at Leeds

THE annual report for 1932 of the Department of Pathology and Bacteriology, University of Leeds, by Profs. M. J. Stewart and J. W. McLeod, recently issued, surveys the teaching and research work carried out in the laboratories. The research work includes investigations on industrial pulmonary diseases, studies in renal function, and on different cultural types of the diphtheria bacillus. In four hæmatite miners an extreme degree of pulmonary fibrosis was detected. In cancer research, Dr. Bonser has obtained results strongly suggesting that it is possible to breed a race of mice which respond very early to tumour induction by means of tar.

The Ross Institute and Hospital for Tropical Diseases

THE annual report and accounts for 1932 of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, S.W.15, records an increase in receipts of £1,051 compared with 1931, and the net loss on the year's working is reduced to £429. Additional donations and annual subscriptions would be very welcome so that the work of the Institute may be extended, and income and expenditure may at least balance. Information is given respecting the activities of the Institute in various parts of the world, particularly in regard to anti-mosquito measures and malaria control, together with a summary of the research work conducted in the laboratories and elsewhere.

Announcements

THE Research Defence Society will hold its annual general meeting at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1, on June 22 at 3 p.m., when the seventh Stephen Paget memorial lecture will be delivered by Major-Gen. Sir Leonard Rogers on "The Saving in Life and Suffering, due to Medical and Veterinary Research, with special Reference to the Tropics".

WE have received from Messrs. W. Watson and Sons the thirty-third edition of their catalogue of microscopic objects. The contents of this list, which are well classified, include a wide range of slides useful for teaching and demonstration purposes, and many that will appeal to the microscopist who desires slides of named species, for example, of diatoms, prepared for careful examination.

ANOTHER volume of collected researches, published from the wards and laboratories of the London Hospital during 1932, has been issued by the Publications Committee (London: H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1. 7*s*. 6*d*. net). The papers included, all of which have been published elsewhere, deal with many branches of the science and art of medicine and form a notable contribution to the subject.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in mathematics at the University College of South Wales and Monmouthshire, Cardiff —The Registrar (June 12). A temporary assistant at the Mersey Laboratory of the Department of Scientific and Industrial Research—The Secretary, 16, Old Queen Street, Westminster, S.W.1 (June 13). Two full-time lecturers in chemistry at the Polytechnic, Regent Street, London, W.1—The Director of Education (June 16). A lecturer in physiological chemistry at Guy's Hospital Medical School—The Dean, Guy's Hospital Medical School, London Bridge, S.E.1 (June 19). A junior scientific officer at the Fuel Research Station, East Greenwich—The Secretary, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, London, S.W.1 (June 19). A full time medical radiologist in the Western Infirmary and University lecturer in the University of Glasgow—J. Matheson Johnston, 87, Union Street, Glasgow (June 21). A professor of electrical engineering at University College, Nottingham—The Registrar (June 21). A principal of the Pontardawe Mining and Technical Institute and Junior Technical Day School—The Director of Education, County Hall, Cardiff (June 22). A lecturer in mathematics and an assistant lecturer in electrical engineering at the Manchester Municipal College of Technology—The Principal (July 1). A professor of mathematics at the Auckland University College, New Zealand—The Secretary of the Universities Bureau of the British Empire, 88a, Gower Street, London, W.C.1 (Aug. 1). A mycologist in the Department of Plant Pathology at Rothamsted Experimental Station, Harpenden—The Secretary (Sept. 15). A professor of organic chemistry at the University of Liverpool—The Registrar. An assistant civil engineer and an assistant mechanical engineer for the Commissioners for the Port of Rangoon—Sir Alexander Gibb and Partners, Queen Anne's Lodge, Westminster, S.W.1.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Development of Fuseaux, Aleuriospores, and Spirals on detached Hairs infected by Ringworm Fungi*

So long as hairs infected with *Microsporon audouini*, *Trichophyton gypseum*, and other ringworm fungi remain attached to the body, the fungi attacking them consist only of hyphæ and small round spores. These spores arise by the rounding-off and disarticulation of the cells of the hyphæ and may be regarded as *chlamydospores*. In contrast to the lack of variety of organs found in a hair stands the number of characteristic structures which are produced when these fungi are grown on synthetic and natural media (Sabouraud[1], Langeron and Milochevitch[2]). Thus *Trichophyton gypseum*, when grown on Sabouraud's maltose-peptone agar, develops: (1) *conidia*, resembling somewhat those of the form-genus *Sporotrichum*, which are termed by medical mycologists *aleuriospores*; (2) large, pleuriseptate, spindle-shaped *macroconidia* which are termed by medical mycologists *fuseaux*; and (3) helically coiled hyphæ, known as *spirals*.

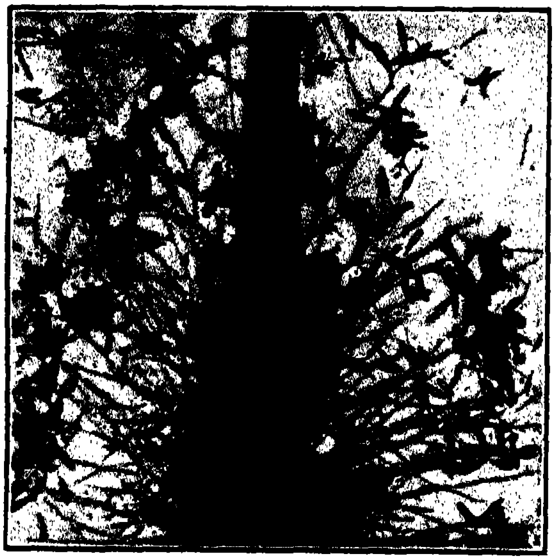

FIG. 1.

FIG. 1.—Human hair naturally infected with *Trichophyton gypseum*, showing development of fuseaux after 16 days in a moist cell without the addition of any nutrient medium. Photographed in air. × 273.

It must be assumed that these organs, hitherto known only in culture, develop only under artificial conditions or else, as Sabouraud[3] has suggested, they form part of a saprophytic stage in the life-history of ringworm fungi which so far has remained undiscovered in Nature.

One characteristic of ringworm is that the hairs on the lesion, when invaded by the fungus, become brittle and tend to break off. It can easily be imagined that hairs from ringworm lesions on animals must often fall to the ground in moist places. An attempt has therefore been made to reproduce experimentally the moist conditions in which such infected hairs may find themselves on reaching the ground.

In August, 1932, a boy suffering from kerion of the scalp—a deep, suppurating form of ringworm—was admitted to the Winnipeg Children's Hospital. His parents believed that he had acquired the disease from infected cattle on their farm. Hairs were removed from the lesion and, when examined with the microscope, were found to be infected with a *Trichophyton* belonging to the ectothrix microides group of Sabouraud. Isolations made from other hairs gave cultures of *Trichophyton gypseum*. Some of the infected hairs were stored in a dry place between sterilised glass slides. A few of the hairs which had remained dry for about six months were caused to hang from the under sides of the cover-glasses of van Tieghem cells, but they were not covered with water or a drop of culture medium. These hairs were then exposed to various conditions of humidity controlled by solutions of known osmotic pressure placed in the bottom of the cells. Thus the hairs and the fungus within them were supplied merely with water vapour.

Germination of the chlamydospores in the hairs suspended in the van Tieghem cells soon took place, and each hair slowly became surrounded by a fringe of mycelium. The ends of many of the hyphæ then thickened and formed macroconidia (fuseaux). These macroconidia increased in size and abundance until they formed a halo around the hair, as shown in the photomicrograph reproduced in Fig. 1.

Not only were macroconidia formed by the mycelium which had grown out of the hairs but conidia (aleuriospores) and spirals also. The conidia were much less conspicuous than the macroconidia, from which they could be readily distinguished by their smaller size and rounded unicellular structure. The spirals were closely coiled and resembled the spirals usually produced in cultures on agar and other media.

Macroconidia (fuseaux) and conidia (aleuriospores) have also been obtained on detached hairs naturally infected by *Microsporon audouini* and by *M. felineum*. Other species of dermatophytes are now being studied with the help of the new technique.

The experiments just described demonstrate that a ringworm fungus present in naturally infected hairs may, when the hairs are placed under suitable conditions of humidity without the addition of any nutrient medium, enter upon a new phase of growth. In this saprophytic stage of the life-history, spore-forms and other organs are produced which hitherto have been found only in artificial cultures.

Although ringworm fungi will grow upon various sterilised natural media, such as horse-dung, straw, and grains of cereals, it has not yet been shown that they can flourish on these substrata under natural conditions which involve competition with other organisms. In the fallen infected hairs, on the other hand, a dermatophyte is in an advantageous position relatively to other organisms. By the time the infected hairs and scales fall from the body, the parasite has thoroughly penetrated their substance and converted much of it into fungal spores. A considerable amount of fungal protoplasm is therefore lying dormant within the hair ready to begin growth at once when brought into a suitable environment. Further, a fungus growing on such keratinised tissues as hair and scales has the advantage of freedom from competition, since it is growing on a substance which few other organisms are able to attack. It is possible that saprophytic stages of ringworm fungi may one day be found in Nature on various substrata other than fallen hairs. However, it may well be that cast-off hairs and epidermal scales are the most important natural substrata on which ringworm fungi pass their saprophytic existence and produce spores capable of infecting new human and animal hosts.

The authors desire to express their thanks to Prof. A. H. Reginald Buller for assistance in the preparation of the manuscript.

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P. H. GREGORY.
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Winnipeg, Canada.
March 27.

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[1] Sabouraud, R., "Les Teignes", Paris, pp. 583–724; 1910.

[2] Langeron, M., and Milochevitch, S., *Ann. Parasit.*, **8**, 422–436, and 465–508; 1930.

[3] Sabouraud, R., *loc. cit.*, pp. 725–727.

A Fly Pest of Timothy Grass

ATTENTION has been directed in recent years to the occurrence of a partial 'stripping' of the flowerheads of Timothy Grass (*Phleum pratense*) before these have emerged from the sheath. In Norway, 1914[1], Sweden, 1912–1916[2], Austria, 1921–1923[3], and Russia, 1928–1929[4], this damage has been traced to the maggots of Cordylurid Diptera, especially *Amaurosoma armillatum* Zett. Similar attacks have been noticed in Scotland and in 1931 Macdougall[5] suggested that "a species of Amaurosoma" might be the cause.

In June and July 1931 we received, from the neighbourhood of Stirling, specimens of the grass showing the damage in progress. The larvæ, which were then feeding, afterwards pupated in soil and were kept in the laboratory until flies emerged in April and May of 1932. These were submitted to the Imperial Institute of Entomology and were identified by Sir Guy Marshall as *Amaurosoma armillatum* Zett. With them were sent flies caught by us, in the original locality, on June 8, 1932, which proved to be of the same species. Some of the latter mated and laid eggs, on Timothy grass, in the laboratory.

The egg is approximately 1 mm. in length, pale yellow in colour, tapering towards both ends, convex and smooth below, having four longitudinal ridges above and a reticulate pattern between these. Similar eggs on Timothy grass were brought in from the field on June 1, 1932. In all cases the egg was laid at the base of a leaf-blade, just above the ligule, long axis parallel to the veins of the leaf, and on a plant of which the flower-head had not yet appeared. We have never found more than one egg on a leaf, seldom more than one on the same plant.

The eggs laid in the laboratory hatched in four to five days and the larvæ gained access to the head, in most cases between the edges of the folded leaves, in one case by perforation of the leaves. Usually not more than one larva has been found in one head. The larva was seen to work round the head and downwards, devouring the flower-buds and cutting off the glumes. As much as one third of the head might be stripped.

When full-fed the insect drops to the ground and pupates immediately beneath the surface of the soil among the roots. It remains in the puparium throughout the following winter. We have found no evidence of a second generation in the year.

Further investigations are being made, in the laboratory and in the field.

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May 8.

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[1] *Review of Applied Entomology*, **3**, A. 107; 1915.

[2] *Ibid.*, **6**, A. 150; 1918.

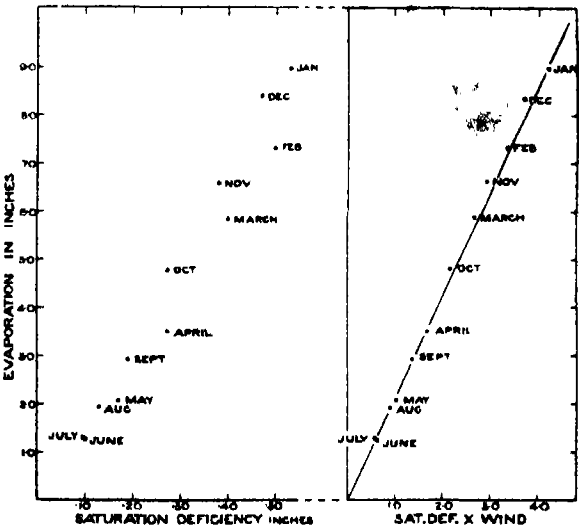
[3] *Ibid.*, **13**, A. 100; 1925.

[4] *Ibid.*, **19**, A. 283; 1931.

[5] *Trans. Highland and Agric. Soc.*, **43**, 139; 1931.

Effect of Rainfall-Evaporation Ratio on Insects Inhabiting the Soil Surface

CERTAIN insects inhabiting the soil surface are markedly affected by soil moisture, largely owing to its influence on the humidity of their surroundings. Soil moisture is primarily dependent on the ratio of rainfall to evaporation (R/E); important secondary factors being soil type and its vegetative covering. If values for the R/E ratio in an area are known, a useful index to the conditions in the micro-environment at the soil surface is available for ecological studies[1]. Evaporation from a free water surface is nearly proportional to the saturation deficit of the air, other variables being constant. Saturation deficit is available for stations where temperature and relative humidity are recorded, and evaporation values can be determined approximately by reference to evaporation records for comparable stations. Owing to the variables involved, particularly wind and the character of the soil surface, the computed values can be only roughly approximate.



(*a*) (*b*)

FIG. 1.

I have used a method with reference to *Sminthurus viridis* L. (Collembola), in South Australia, to show the months in which the species will occur and its probable geographical distribution over the State.

In Fig. 1(*a*) the mean evaporation each month at Adelaide is plotted against saturation deficit. Values for the latter were calculated from the mean relative humidity (9 a.m.) and mean air temperature. In Fig. 1(*b*) the saturation deficiency value was multiplied by the mean total wind miles for the month (abscissa)[2]. The significance of the wind factor is clearly shown.

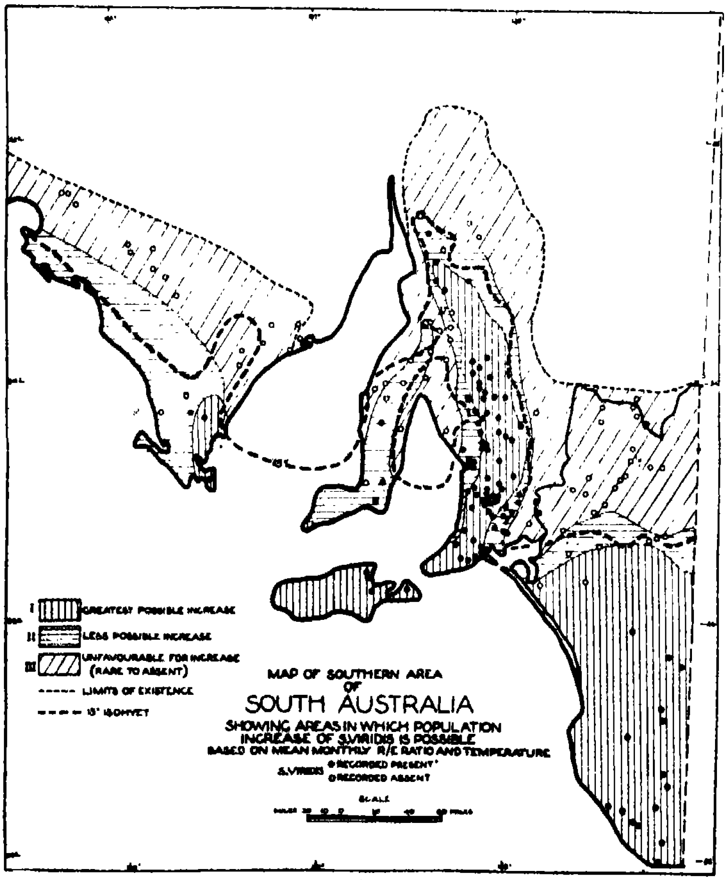

I GREATEST POSSIBLE INCREASE
II LESS POSSIBLE INCREASE
III UNFAVOURABLE FOR INCREASE (RARE TO ABSENT)
LIMITS OF EXISTENCE
15" ISOHYET
MAP OF SOUTHERN AREA OF SOUTH AUSTRALIA
SHOWING AREAS IN WHICH POPULATION INCREASE OF S.VIRIDIS IS POSSIBLE
BASED ON MEAN MONTHLY R/E RATIO AND TEMPERATURE
S.VIRIDIS ● RECORDED PRESENT ○ RECORDED ABSENT
SCALE

FIG. 2.

The mean monthly saturation deficit was obtained for 21 stations in the State, from temperature and humidity records, and monthly evaporation values were calculated by reference to evaporation data for Adelaide. In making the computations, values for wind were considered to be the same as for Adelaide. Mean monthly rainfalls from 220 stations (including the 21 stations above) were used and maps were prepared showing the areas and months in which rainfall exceeds evaporation. The ratio $R/E = 1$ was taken as the critical value below which the conditions may become too dry for the active stage of *Sminthurus*. From these maps, together with monthly isotherms, the areas in the State climatically suitable for population increase of *S. viridis* were defined (Fig. 2). The values for R/E and for temperature in relation to development were used to indicate the months in which the greatest increase may occur. The predicted areas agree closely with the actual records. In areas II and III, soil type and absence of suitable food plants are important edaphic factors restricting the spread of the species in certain districts. The presence of the insect on the swamps along the River Murray in areas II and III is due to soil type and artificial irrigation. The work will be described in full in the *Australian Journal of Experimental Biology and Medical Science*.

JAMES DAVIDSON.

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University, Adelaide.
March 8.

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[1] Livingston, E. B. and Shreve, F., Carnegie Institution of Washington, Pub. No. 284, 1921.

[2] Data from Official Yearbook, Comm. Australia, p. 23; 1930.

Insect Transmission of Virus *A* of Potatoes

IT has been proved in previous work carried out in this laboratory that the crinkle disease of potatoes is a virus complex caused by the combination of the virus of simple mosaic and a hitherto undescribed constituent which has been designated virus *A* by Murphy and McKay[1]. It had already been shown by Salaman[2] that crinkle was not transmitted as such by needle inoculation, and it is now well established that the disease obtained in this way is equivalent to a simple mosaic or to the needle-borne but not aphis-borne disease (due to virus *X*) secured by K. M. Smith[3] from Up-to-Date. In other words, virus *A* is dropped on needle inoculation.

When attempts were made to transmit crinkle by means of the aphis *Myzus persicæ*, Sulz. it was found that the full crinkle complex was not produced, but that there resulted in healthy President potato a form of veinal mosaic of a mild nature. Crinkle originating from both President and Irish Chieftain gave the same result. Examination of this disease showed that it was not simple mosaic, for it produced acronecrosis by grafting on British Queen and Up-to-Date and vein-banding by needling to tobacco. Attempts to infect *Datura Stramonium* by needle, graft and aphis produced no visible symptoms. These manifestations are the characteristics of virus *A*. When simple mosaic was grafted on President containing the aphis-transmitted disease, typical and persistent crinkle symptoms developed in the stock plants.

Virus *A* was also transmitted direct from Irish Chieftain potato carrying this virus by means of *Myzus persicæ* to healthy President, British Queen, Up-to-Date, tobacco, and President containing a simple mosaic derived by needle inoculation from crinkle. The results were the same as before: a mild veinal mottle resulted in healthy President, acronecrosis in British Queen and Up-to-Date, vein-banding in tobacco, and crinkle in President containing simple mosaic.

It is, therefore, clear that *Myzus persicæ* is an efficient vector of virus *A* from potato to potato and tobacco, and so far as crinkle is concerned it transmits it selectively to the exclusion of the simple mosaic element. This is very convenient in experimental work, since virus *A* is otherwise inoculable with difficulty. On the other hand, if another virus were present of which *Myzus persicæ* was also a vector, it is likely that the insect would transmit both. The aphis-borne virus (afterwards identified as *Y*) transmitted by *Myzus persicæ* from the crinkle in Myatt's Ashleaf used by K. M. Smith[4] was not identical with virus *A*, as is seen, among other reasons, from the fact that Smith's *Y* was readily returned by needle from tobacco to potato, in which it produced 'crinkle and leaf-drop streak' in the variety President. Virus *A* is not so returnable, nor does it ever in my experience produce such symptoms in this variety. As Murphy[5] has already suggested, it is possible that virus *A* was also present in Smith's crinkle, in which case it would be carried by the insect along with *Y*, and since both produce similar vein-banding symptoms in tobacco, no evidence of its presence in that plant would be available, while the effect of this particular *Y* on President was so severe that the faint symptoms of *A* would not become visible.

There is some evidence to show that *Myzus circumflexus*, Buckt. may also act as a vector of virus *A*. *Macrosiphum solani*, Kalt. (*Myzus pseudosolani*, Theob.) failed to transmit the virus, as did the capsids *Lygus pabulinus*, Linn. and *Calocoris bipunctatus*, Fabr.

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April 21.

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[1] Murphy, Paul A. and McKay, Robert, *Sci. Proc. Roy. Dublin Soc.*, **20** (N.S.), **20**, 227–247 ; 1932.

[2] Salaman, R. N., *Proc. Roy Soc.*, B, **106**, 50–83 ; 1930.

[3] Smith, Kenneth M., *Proc. Roy. Soc.*, B, **109**, 251–267 ; 1931.

[4] *Ann. App. Biol.*, **17**, 2, 223–240 ; 1930.

[5] Murphy, Paul A., *Sci. Proc. Roy. Dublin Soc.*, **20** (N.S.), **18**, 193–210 ; 1932.

Insects and Micro-Climates

MESSRS. LEESON and Mellanby have directed the attention of entomologists to the changes in temperature in small local areas due to evaporation[1]. The present communication is offered in elaboration of their suggestion.

In Morelos, Mexico, there is a long dry season—September to May—followed by a period of steady rains from June through July, August and part of September. In July, during the rains, the relative humidity may stay so high as 90 per cent for days ; while in March, the height of the dry season, it may go so low as 15 per cent. This very low humidity, however, is in all probability never experienced by the Mexican fruit fly, *Anastrepha ludens* (Loew) ; nor for that matter, the high temperature of the day. Direct observations of the flies during the hot arid days showed that they favour the under side of the leaves of the mango trees. The thickness of the foliage of these trees and their high rate of transpiration account for a difference of ten degrees and more (Fahrenheit) from the periphery to the centre of the tree. Transpiration takes place almost entirely on the lower side of the leaves ; and there the flies are to be found during the dry season.

The mango is the chief host of the Mexican fruit fly in Morelos. Up to the present, the attention of observers generally has been focused exclusively on the suitability of the mango fruit for the egg and larval stages of the fly. In this, I think, we have been in error. The compactness of the foliage and the amount of transpiration render the tree itself highly suitable as an environment for the adult flies in respect to temperature. The latter move about surprisingly little in the course of their lifetime, indulging only in short circular flights in ordinary circumstances ; and as mango fruits are entirely acceptable as an egg-laying medium, a high degree of infestation—about 99 per cent—is the result.

The same kind of effect can be observed in the case of *Opius crawfordi* (Vier), the chief parasite of *Anastrepha ludens*. A study of *Opius* adults was made under laboratory conditions, and showed that the difference between 20 and 45 per cent relative humidity is physiologically enormous, when judged by mortality figures. Under field conditions, *Anastrepha* larvæ in sweet limes are parasitised by *Opius* to a very much lesser extent than larvæ in mangos, even though both types of tree grow in close proximity in the same grove. It was found that the humidity among the open-branched sweet lime trees is very much lower than among the densely foliaged mangos.

The concept of an association between insect and host fruit should be broadened to include the tree itself. The rate of transpiration of a host plant may be a determining factor in the survival of an insect, for two reasons : the lowering of the air temperature by evaporation from leaf surfaces, and the local increase in atmospheric humidity from the same source.

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[1] NATURE, **131**, 363, March 11, 1933.

Efficiency of Anti-Stokes Fluorescence in Dyes

ACCORDING to Kautsky and his collaborators[1], the majority of the molecules of dyes investigated by them, among which were also the molecules of fluoresceine, show an ability to phosphoresce when 'energetically isolated', for example, when adsorbed by convenient adsorbents. We can assume therefore that in such molecules there must be at least one metastable energy level *M* (Fig. 1), situated lower than the level *F* reached immediately after absorption. From the state *F* the molecules can pass either to a normal state *N*, emitting the band *F–N* (fluorescence), or to the metastable state *M*. The probability of the transition *M–N* is very small. Therefore when the temperature is sufficiently high, a great majority of molecules will be raised thermally from the level *M* to *F* and will be able to emit the band *F–N* (phosphorescence at room temperature). At low temperatures, direct transitions *M–N* take place. These transitions are accompanied by the emission of a phosphorescence band which is displaced towards the red relatively to band *F–N* ; the duration of phosphorescence increases greatly (phosphorescence at low temperatures).

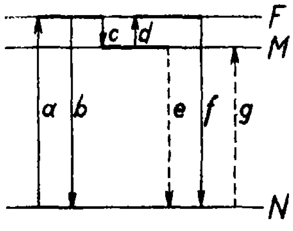

FIG. 1.—Energy levels in a phosphorescent molecule. *a*–absorption, *b*–fluorescence, *c*–transition to metastable level, *d*–thermal excitation, *e* and *f*–phosphorescence, *g*–absorption of very small transition probability.

As the mean life τ of the state M is much longer than that of the level F, the phosphorescence is quenched appreciably more than fluorescence. This follows from the formula[2] $I = \frac{I_0}{1 + k\tau}$, where k is the probability of a quenching act, I the observed intensity of photoluminescence.

The absorption band N–M (inverse transition) must also appear if the transition M–N take place, notwithstanding its small probability. However, it will have a very small intensity as compared with band N–F.

Under the influence of disturbing fields, for example of the surrounding molecules of the solvent, the probability of transition N–M can become appreciably greater than that of the isolated molecule. In solutions, practically all the molecules which have reached the level M in any possible way will be quenched. Therefore the absorption band N–M must be completely inactive.

Such inactive bands, overlapping on the longer wave-length side the active absorption bands (N–F), can cause the falling off of efficiency as observed in fluoresceine solutions[3,4,5]. It is to be noted in this connexion, that in the region of abrupt falling off of yield, the values of absorption coefficients of fluoresceine solutions reach only from 0·2 to 2 per cent of the maximal value.

In the above considerations I have supposed for the sake of simplicity that the levels for absorption and emission acts are identical. I have dealt elsewhere with the relative displacements of emission and absorption bands.[6]

A. JABŁOŃSKI.

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April 14.

[1] H. Kautsky, "Energieumwandlungen an Grenzflächen", *Ber. Deutsch. Chem. Ges.*, **64**, 2053 and 2077; 1931; and **65**, 401; 1932.

[2] O. Stern and M. Volmer, *Phys. Z.*, **20**, 183; 1919.

[3] S. Valentiner and M. Rössiger, *Z. Phys.*, **36**, 81; 1926.

[4] S. I. Wawilow, *Z. Phys.*, **42**, 311; 1927.

[5] A. Jabłoński, *Acta Phys. Pol.*, **2**, 97; 1933.

[6] A. Jabłoński, *Z. Phys.*, **73**, 460; 1931. See also P. Pringsheim, "Handb. d. Phys.", **23**, Part 1, second edition, 244.

Interaction between Radio-Waves?

THE coming into operation of the Luxembourg high-power broadcasting-station on a wave-length of 1190 m. has caused the following remarkable phenomenon. For the first time on April 10 of this year it was observed at Eindhoven, Holland, that when a radio-receiver was tuned to Beromünster (460 m.), the modulation of the Luxembourg station could be heard on the background to such an intensity that during the weak passages of the programme of Beromünster the programme of Luxembourg was heard with an annoying strength. Since the field-strength of Luxembourg at Eindhoven has the quite normal value of about 10 mv./m. (the distance from Luxembourg to Eindhoven is somewhat more than 200 km.) and the same phenomenon was observed with different types of receivers, this cannot be due to cross-modulation in the receivers. It was also observed with a battery set away from the electric distribution system of the town, so that any disturbing influences from these sources were eliminated. Hence it seems that the phenomenon has its origin somewhere in the transmission between Beromünster and Eindhoven. It may be remarked that Luxembourg is situated nearly on the line joining Beromünster and Eindhoven.

Since the first observation the same phenomenon has been observed at Eindhoven with different intensities on Radio Paris (1725 m.), Budapest (550 m.), Munich (533 m.), Lyons la Doua (466 m.), Sottens (404 m.), Mühlacker (361 m.), Strasbourg (345 m.), Milan (332 m.), Poste Parisien (328 m.) and Frankfurt (259 m.), which all lie somewhat in the direction from Eindhoven to Luxembourg and at a greater distance from Eindhoven than Luxembourg. It has also been observed on Beromünster at Rotterdam, near Arnhem and at Düsseldorf. It was always the modulation of Luxembourg which could be heard on the background. This modulation has not been observed on Langenberg (472 m.) and Brussels (509 m., 338 m.), or on a British station.

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Kinetics of the Iodine-Oxalate Reaction

SINCE 1916, when one of us[1] reported that this reaction is very sensitive to light and that the dark reaction has a high temperature coefficient, a large amount of work has been carried out on this chemical change by several chemists[2].

The majority of workers believe that the velocity of this reaction in light is not directly proportional to the light intensity but varies as the square root of the intensity of the incident radiation, although Bhattacharya and Dhar[3] have observed that by using an aqueous solution of iodine in the absence of potassium iodide, the relation between velocity and light intensity for this reaction approaches unity in radiations of mean wave-lengths 5650 A. and 7304 A.

We have carried out further experiments on this reaction using normal potassium oxalate and $N/850$ aqueous solution of iodine without the addition of potassium iodide, and some of the results are as follows:

	Dark	8750 A.	8500 A.	3340 A.	3512 A.	3452 A.	3125 A.	3536A.
$k_{28^\circ}/k_{18^\circ}$	4·64	3·92	3·54	2·02	2·25	2·38	2·38	2·44

When potassium iodide ($N/277$) was added to the reaction mixture, the velocity was greatly diminished and $k_{32^\circ}/k_{22^\circ}$ assumed the high value 8·84 in the dark.

In the absence of potassium iodide and with normal oxalate and $N/850$ iodine, the following results were obtained for the relation between light intensity and velocity:

Wave-length in A.	Observed ratios of velocities	Ratio of light intensity
3500	1·32	4
3340	1·79	4
3536	3·25	6·25
8500	3·97	4·34
8750	2·71	2·44

It appears that the relation between the velocity and light intensity varies from 1/3 to 5/4 approximately. Several other photochemical reactions taking place in aqueous solutions behave in a similar manner. It is now well known that the photochemical reactions between chlorine and hydrogen and bromine and hydrogen in the gaseous state are proportional to the square root of the light intensity under certain conditions and are directly proportional to the light intensity under other conditions. We have shown experimentally and theoretically that the relation between the velocity and the light intensity (or the amount of absorbed light) in a photochemical change is not constant but changes with the acceleration of the reaction by light absorption[4].

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[1] Dhar, *Proc. Akad. Wetensch. Amsterdam*, **18**, 1084; 1916.
[2] Berthoud and Bellenot, *Helv. Chim. Acta*, **7**, 307; 1924. Briers, Chapman, and Walters, *J. Chem. Soc.*, **129**, 562; 1926. Mukerji and Dhar, *J. Phys. Chem.*, **32**, 1308; 1928. Allmand and Young, *Faraday Soc. Discuss.*, 515, April 1931. Young and Style, *ibid.*, 493. Griffith and McKeown, *Trans. Faraday Soc.*, **28**, 752; 1932.
[3] Bhattacharya and Dhar, *J. Indian Chem. Soc.*, **6**, 473; 1929.
[4] Dhar and Bhagwat, *Z. Anorg. Chem.*, **190**, 415; 1930. Malaviya, Dhar and Bhagwat, *ibid.*, **199**, 406; 1931. Dhar, "Chemical Action of Light", Blackie and Son, 1931.

Ultra-Violet Bands of Oxide of Phosphorus

THE Phosphorus arc in air gives out a band spectrum in the ultra-violet, which is attributed to the PO molecule. The vibrational quantum analysis of these bands has been previously done by one of the authors[1]. The rotational structure analysis of the (0, 0) band at λ 2477·80 shows that it consists of six main branches, namely, $P_1\ Q_1\ R_1$ and $P_2\ Q_2\ R_2$ and two other faint satellite branches. For low quantum numbers, the satellite branches ${}^{R}Q_{21}$, ${}^{Q}P_{21}$, ${}^{P}Q_{12}$ and ${}^{Q}R_{12}$ are superposed on the main branches. The intensity of the lines of the different branches satisfy the criterion of a ${}^2\Sigma \rightarrow {}^2\pi$ transition. The band structure is analogous to the ν-bands of NO_1 as is anticipated from theoretical considerations. The following molecular constants (cm.$^{-1}$ units) have been obtained.

$$\nu'_e = 1{\cdot}416 \times 10^{3} \qquad \nu''_e = 1{\cdot}458 \times 10^{3}$$

$$B'_e = 1{\cdot}3060 \qquad B''_{e\,(\frac{\pi}{2})} = 1{\cdot}2332;\ B''_e\,({}^{2}\tfrac{\pi}{2}) = 1{\cdot}2256$$

$$D'_e = -4{\cdot}60 \times 10^{-6} \qquad D''_{e\,(\frac{\pi}{2})} = -4{\cdot}96 \times 10^{-6};$$

$$D''_{e\,({}^{2}\frac{\pi}{2})} = -4{\cdot}86 \times 10^{6}$$

$$\alpha' = \alpha'' = 0{\cdot}0073$$

The detailed results will be published elsewhere.

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[1] P. N. Ghosh and G. N. Ball, *Z. Physik.*, **71**, 302; 1931.

Conductivity of Mixtures of Gases

IT is well known that the electrical conductivity of certain gases may be greatly increased by the addition of very small quantities of other gases. For example, the electrical conductivity of pure helium is greatly improved by the addition of 0·01 per cent of pure argon. In gases, the electrical conductivity in uniform fields between parallel plates depends upon the ratio X/p, where X is the electrical intensity in volts per centimetre, and p is the pressure in millimetres of mercury, and is a maximum for a certain value of X/p depending upon the nature of the gas. The photo-electric currents obtained with a constant force between parallel plates at different distances apart are represented by the ordinates of the curves, Fig. 1, and the potential differences between the plates by the abscissæ. The three curves give the currents in pure helium, in pure argon and in helium containing 0·025 per cent of argon. The values of the ratio X/p were, 50 in pure helium, 200 in pure argon and 15 in the mixture. Under these conditions the rate of increase of the current with the distance between the plates was a maximum.

Two theories have been advanced to account for the increase in conductivity of the mixture, namely, the action of direct collisions of electrons with the atoms of argon, and the action of metastable atoms of helium which are formed by electron collisions with helium atoms. These metastable atoms of helium may be formed when the electrons attain an energy corresponding to approximately 20 volts. It is then supposed that the metastable atoms of helium ionise the atoms of argon, which require an energy corresponding to approximately 16 volts. There is much controversy concerning the relative importance of these two processes. For example, Penning[1] states that the increase in conductivity may be attributed entirely to metastable atoms, whereas Townsend and McCallum[2] have pointed out that the effect of direct collisions of electrons may be considerable in these circumstances.

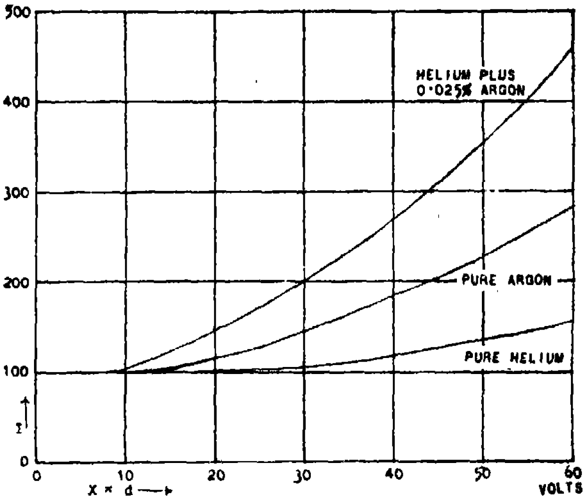

FIG. 1.—Conductivity between parallel plates. *I*, current between plates in arbitrary units; *X*, forces between plates in volts per centimetre; *d*, distance between plates in centimetres.

The results given in Fig. 1 are of importance in showing that a large number of new ions are formed in the mixture of 0·025 per cent of argon in helium when the potential between the plates is increased from 9 volts to 18 volts, the distance between them being adjusted so as to maintain a constant force. As no metastable atoms of helium could be formed until the electrons attained an energy of 20 volts, the increase in conductivity in these circumstances must be attributed to the direct collisions of electrons with argon atoms. It would not appear from the curve that any important new process occurs when the potential between the plates exceeds 20 volts, such as might be attributed to the action of metastable atoms.

More complete results will shortly be published elsewhere.

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April 24.

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[1] F. M. Penning, *Physica*, **12**, 65; 1932.
[2] J. S. Townsend and S. P. McCallum, *Phil. Mag.*, **5**, 695; 1928.

Determination of Crystal Lattice Constants by Electron Diffraction

THE accuracy of the determination of crystal lattice constants by electron diffraction has hitherto been limited by various sources of error, chief of which is that due to the lack of precision attendant upon the measurement of high voltages. We have recently succeeded in eliminating this and other sources of error in the following manner:

A double specimen, mounted as required either for transmission or reflection, is employed. One half consists of a substance the lattice constants of which are known, having been determined by exact X-ray analysis; the other half of the specimen consists of the substance of unknown lattice constants. The shutter of the diffraction camera is in two halves each capable of independent operation. The electron beam penetrates or impinges upon one half of the specimen and the corresponding electron diffraction pattern is recorded upon one half of the photographic plate. Thereupon the specimen is either traversed through the beam or rotated in the azimuthal plane, thus bringing the second half of the specimen under examination. The hitherto unexposed half of the photographic plate is now exposed. The accompanying reproduction (Fig. 1) of a transmission photograph obtained in the manner outlined above will serve to make clear the principle underlying the method, which is analogous to the use of the iron-arc reference in spectroscopy.

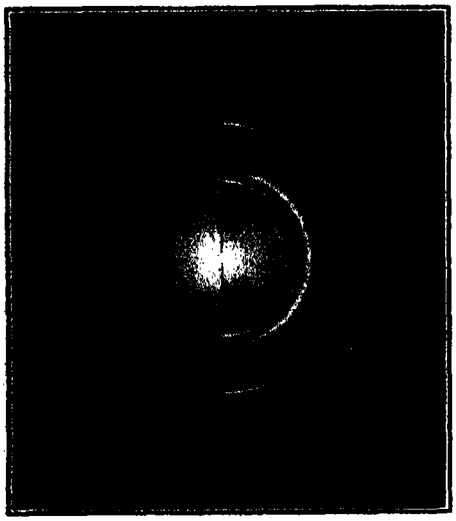

FIG. 1.

A more detailed account of this method will be published shortly.

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Selective Lattice Distortion in Wires under Torsion

X-RAY analysis of metals affords a means of detecting the type of internal strain which is accompanied by distortion of the crystal lattice. The distortion is reflected in the X-ray diffraction photographs in that it causes a broadening of the spectrum lines; the effect has been noted for metals which have been cold-worked or which contain a highly dispersed solute.

I find that lattice distortion is produced also in wire (copper, nickel) under torsion, and a point of particular interest appears. Since torsional stress can be applied gradually, the rate of broadening of lines from different planes can be compared. It is found first, that the (420) planes distort more rapidly than do the (331); and, secondly, the lines do not broaden continuously with increasing stress, but exhibit instead alternating periods in which their definition is partially recovered.

The selective distortion of the planes is of such an order that the (331) $K\alpha_1\alpha_2$ doublet is easily discernible after the (420) doublet has diffused into a single broad line. The recovery effect is most marked on the (331) line; the doublet diffuses and reappears, though to a less and less degree, as the torsion of the wire is increased.

The observations implement the view that lattice distortion grows, as stress is applied, to the maximum characteristic of the metal; that the more highly distorted grains disrupt, and then tend to re-crystallise, presumably adopting a more convenient orientation, in a temporarily less distorted state. The latter stage would coincide with the recovered definition of particular lines.

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May 8.

Extension of the Visible Absorption System of NO_2 to Longer Wave-Lengths

IN two recent letters to NATURE, Cassie and Bailey[1] as well as Harris, Benedict and King[2] report new investigations of the infra-red and ultra-violet absorption spectrum of NO_2. We should like to remark that we have recently made new investigations of the *visible* absorption system of NO_2 which, as is well known, is extremely complicated. In consequence of this, neither its vibrational nor rotational structure has as yet been analysed. A possible explanation for this complicated structure is that, in consequence of the Franck-Condon principle, chiefly the higher vibrational levels in the upper state are excited.

On this assumption it was to be expected that the system would extend to longer wave-lengths with sufficient absorbing length and there become more simple. This proved in fact to be the case. We have found a rather simple series of bands starting at about 8900 A. and extending to shorter wave-lengths. The distance between the main bands is about 740–730 cm.$^{-1}$. This must be a vibrational frequency of the upper state.

We are engaged now in the investigation of these new bands with longer absorbing layers and with high resolution. On account of the absence of overlapping of different bands in the region now being investigated, it seems very likely that it will be possible to analyse the vibrational and rotational structure.

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[1] NATURE, 131, 239, Feb. 18, 1933.
[2] NATURE, 131, 621, April 29, 1933.

Research Items

Social Organisation and Marriage in Madagascar. An account of the culture of the Tanala, a group living on the southern third of the eastern massif of Madagascar, which was visited by the Marshall Field expedition to Madagascar, 1926, has been prepared by Mr. Ralph Linton (Pub. 317, Anthrop. Ser., 22, Field Mus. Nat. Hist.). The Tanala live at the meeting point of four fairly distinct cultures. They are, and would appear to have been always, an agglomeration of groups, of which the composition was continually changing. Yet their culture is fairly uniform in its details, and in comparison with that of the rest of Madagascar, relatively simple and archaic. The social organisation, as in other groups of Madagascar, is based on a combination of two factors, common descent and common residence. Next to the family, the smallest group is the lineage, a local group of relatives, who claim descent from a common ancestor in the male line. Next comes the gens and then the tribe, the latter not necessarily an organic unit, but often a group of gentes brought together by conquest or alliance. The family consists of the man, his wife, or wives, and their children, the father in theory being absolute, not only over his own children, but over his son's children as well. In one of the two main divisions, the Ikongo, however, the mother has authority over the children, while control of the property is vested in the father. Marriage between different generations, or within the lineage is undesirable, and formerly there was a strong feeling in favour of marriage within the village. The Ikongo, however, in their fear of incest, favour marriage outside the village. Relationship affecting marriage is reckoned by blood, marriage and 'blood-brotherhood'. Among the Menabe marriage between the descendants of two sisters traced in the female line is absolutely forbidden. Cross cousins are urged to marry and marriage of cross cousins in the second generation is considered the most desirable form of union. The bride-price legalises the union. It is not returnable, except among the cattle tribes, and even there only in theory and not commonly in practice, as it determines the rights in the children.

'Western Indian' Art. An interesting document relating to the comparatively little-known Jains has been edited by Prof. W. Norman Brown, professor of Sanskrit in the University of Pennsylvania, and published by the Freer Art Gallery of the Smithsonian Institution, Washington (Oriental Studies, No. 1). The manuscript, which was purchased by Prof. Brown at Benares in 1922, is in folio, written in gold ink on a specially prepared background of red, black or blue, and illustrated with seven primitive paintings in brilliant colouring and of skilled draughtsmanship. It deals with the story of the monk Kalaka, one of the saints of the Jain cult, a pseudo-historical figure. Apart from the historic and religious interest of Jain manuscripts, they are of importance for the history of Indian art, an aspect which, virtually, has been neglected. They form a school, for which Dr. Brown suggests the name 'Western Indian', which preceded and on the Indian side was the parent of Moghul and Rajput art. The school lasted from the beginning of the twelfth to the seventeenth century. A peculiar characteristic of the school in drawing is the externalisation of the second eye in the representation of the profile, a feature also found, Dr. Brown notes, in paintings at Pagan in Burma. Dr. Brown thinks that among the Jains it is an attempt to represent the protruding glass eyes of the stone figures in Jain temples. It may be pointed out, however, that externalisation of the eye is a common feature in primitive drawings. If this were indeed a primitive feature, it would not be the only primitive convention surviving in Indian art.

Life-History of *Calanus finmarchicus*. During the year 1931–32, the work of the staff of the Scottish Marine Biological Association's station at Millport has been concentrated mainly on the copepod *Calanus finmarchicus*, one of the chief foods of the herring and also an important constituent of the food of young fishes of other species (Scottish Marine Biological Association: Annual Report, 1931–32. Pp. 1–24. Glasgow: 185 St. Vincent Street). As the result of well-regulated team work, the complete life-history of this copepod crustacean is being pieced together, and the physical, chemical and other conditions which determine its abundance slowly but surely ascertained and recorded. After an incubation period of about twenty-four hours, *Calanus* hatches out from the egg as a nauplius larva. This nauplius then moults through five more nauplius stages, after which it enters into a kind of intermediate or pre-adult phase known as the first copepodite stage. There are, in all, six copepodite stages, of which the last is the true adult. *Calanus* stops breeding in the autumn, most of the population which exists through the autumn and early winter being pre-adults of stage 5. During this resting season the total numbers show a steady decrease, so that very few *Calanus* are present when eventually moulting into the final adult form begins. Males appear first and females predominate later. Eggs are then laid and the brood produced develops quickly, producing full adults in about a month. By this time the parent (autumn) brood has entirely died out. The size of the *Calanus* remains the same throughout the autumn, but the winter brood consists of much larger animals. In addition to these studies of the *Calanus* population as a whole, detailed laboratory work is also being carried out on the digestive, respiratory, and other physiological activities of these animals.

The Arachnid Group, Opiliones-Laniatores. Dr. W. Sørensen, who died in 1916, left a number of descriptions of species of harvesters, and notes on their families and genera, which would have formed part of his proposed monograph on the sub-order Laniatores of the Opiliones. These manuscripts have been revised, first by Dr. C. With and latterly by Dr. K. L. Henriksen, and are now published (*Kong. Danske Vidensk. Selsk. Skr.*, 9, iii, 4, pp. 199–422) as a memorial to the extensive work done by Sørensen on these Arachnida. In Prof. C. F. Roewer's classification, the Laniatores were divided into six families, with thirty-two sub-families. The present work covers five of these families, but arranges them in five super-families and fourteen families. Three of these families are new; twenty new genera are also established and many new species from all parts of the world are described. All diagnoses are in Latin and the editor's notes are in English. These give the history of the specimens examined and make clear the relationship between the systems of Sørensen and Roewer. The work is of considerable interest as a supplement to Roewer's great volume, "Die Weberknechte der Erde", 1923, and a fitting tribute to the memory of its author.

Disinfection of Glasshouses with Sulphur. Burning sulphur as a means of disinfecting vacant glasshouses has been found liable to result in a serious type of damage to a subsequent chrysanthemum crop (*J. Min. Agric.*, 39, 1085). The injury, which has frequently been encountered by growers, could not be traced to any fungal, bacterial or insect pest and had hitherto remained beyond control. Investigations by W. H. Read and O. B. Orchard of the Cheshunt Research Station, however, have shown that the scorching and wilting of the plants is due to zinc sulphate, formed on the overhead galvanised wires and painted surfaces and conveyed to the plants in drops of condensation water. Confirmation of the cause of damage was obtained by the production of similar injury when solutions of zinc sulphate were applied directly to the plants, 1 part of the salt in 300 of water being the maximum amount tolerated without visible injury resulting. No trouble was experienced if a lead or barium paint were substituted for 'zinc white' or if the atmosphere were kept very dry, but prevention of damage by means of these alternatives has obvious disadvantages. In the event of burning sulphur having already been used as a disinfectant, the possibility of damage can be greatly minimised if the house is thoroughly hosed down with water at frequent intervals. The substitution of another type of fumigant such as naphthalene or formaldehyde is, however, to be preferred. The use of sulphur as a dusting powder, on the other hand, is quite a safe procedure, as it is only when burnt that the formation of zinc sulphate takes place.

Disintegrating Action of Roots of Trees. In *Current Science* (Vol. 1, No. 3, 78, Sept. 1932) a brief account was published of the work of Mr. Mohammad A. R. Khan, principal of Osmania University College, on the "Disintegration of Igneous Rocks due to the Action of the Roots of Certain Rock-loving Plants", the observations having been made in the Deccan. The species more specifically referred to were *Carissa carandus*, *Gymnosporia montana*, *Butea frondosa* and *Anona squamosa*. A communication to NATURE, which we are unable to print in full, reports further investigations of this phenomenon. Mr. Khan attributes the extraordinary positions taken by the fantastically rounded igneous rocks of the Deccan in large part to the action of the roots of certain trees. Amongst these he considers that *Gymnosporia montana*, which is found for hundreds of miles in the rocky districts round about the city of Hyderabad, is the most formidable rock-disintegrator. It is well known that the roots of plants and trees exert an enormous influence in breaking up rocky strata beneath the surface of the superimposed soil layers; and that this is accomplished by the finer rootlets penetrating into tiny crevices and, through their subsequent growth in diameter, disintegrating the previously homogeneous mass. It is perhaps not so commonly appreciated that this action proceeds at a much more rapid pace in tropical countries, owing to the greater heat and moisture conditions. But Mr. Khan's observations would appear to show that the vegetation and the masses of smaller rootlets, which form a kind of lacework over the bases of the individual rock pieces of the curious Deccan formation, play a larger part in the disintegration and break up of the surface rocks than may have been so far attributed to it. "Where," he says, "the rocks are in contact with the soil (already formed) and the fine root-hairs of these plants have reached them, they (the root-hairs) enter the cracks and gradually draw upon the felspars and ferro-magnesium silicates for food. . . . These root-hairs spread over the rocks and permeate into the rocky material far and wide . . . producing a specific disintegration".

Spectrograph for Study of Fibrous Substances. Messrs. Adam Hilger, Ltd., have recently added to their X-ray diffraction apparatus a spectrograph constructed for the study of such fibrous substances as cotton-wool or silk. It is designed by Mr. W. T. Astbury of the University of Leeds, whose experience in such work is such as to ensure its construction on practical lines. The spectrograph proper is simple and follows orthodox lines. It consists of a collimator of variable aperture, specimen and plate holders mounted rigidly on a graduated triangular steel bar. A sector mounted on the plate holder enables photographs from the same fibre under different conditions or from different fibres to be obtained on the same plate and thus facilitates the detection of any change in lattice size. In such an apparatus the accessories are most important and the new spectrograph is very fully equipped in this respect. Among the fittings supplied with it are frames for mounting fibres in different positions relative to the X-ray beam and under different conditions of tension. Attachments are also provided to enable fibres to be studied under varying humidity conditions and during treatment with steam or acids. The apparatus is essentially practical and should have important applications.

Hyperfine Structure and Nuclear Moments. In *Current Science* (vol. 1, pp. 264 and 303, 1933) Prof. B. Venkatesachar and L. Sibaiya give the nuclear spins of zinc (½), caesium (5/2) and sodium (½) as obtained from hyperfine structure observations with the use of Lummer plates and a new type of source. The experimental value given for zinc has been deduced by a somewhat arbitrary selection of some of the reported components, and differs from the value 3/2 given by Schüler and Westmeyer (*Z. Phys.*, 81, 565; 1933). The intensities of the observed components, however, are not even in approximate agreement with the known abundance percentage of the odd isotope, and it seems quite probable that the observations were affected by ghosts or self-reversals. The values given for caesium and sodium [illegible] obtained from intensity measurements of [illegible] resonance lines, and are not in agreement with [illegible] based on a more rigorous analysis. The spins of the alkali metals are discussed in relation to a theory of nuclear spins previously proposed by Venkatesachar and Subbaraya (NATURE, 131, 552, April 15, 1933), but this discussion is based on early results now known to be inaccurate, and adds nothing to the known facts. An elaboration is made of Venkatesachar and Subbaraya's theory which predicts the spins for most of the elements of the periodic table. A critical examination of the theory, however, suggests that agreements between predicted and observed values are fortuitous, arising largely because for most elements a whole regular series of alternative values is given, the observed value naturally agreeing with one of these. It follows that the predicted value for cæsium (5/2) carries no weight.

Analysis of Cast Iron. The British Cast Iron Research Association has recently published a monograph on "Recommended Methods for Sampling and Analysis of Cast Ferrous Metals and Alloys" (Special Publication No. 1. Pp. 44. *Birmingham.* 10*s.* 6*d.*), which will be found of great value by all who have to deal with cast iron and its uses in industry. The analysis of cast iron presents difficulties of its own, which begin with the sampling, special care being necessary in order to ensure that the quantity taken for analysis is representative of the composition of the metal. The precautions which should be taken are well described. Owing to the increasing use of alloy cast irons, where increased strength or resistance to chemical attack or to oxidation at high temperatures is required, the analyst must be prepared to look for elements other than those found in ordinary pig iron, including nickel, chromium, aluminium, copper, cobalt, molybdenum, tungsten, vanadium and titanium, and the analytical methods become correspondingly complex. The procedures here described are those which have proved themselves in the course of the life of the Association, during which the staff has had to conduct the analyses needed in the course of the research work undertaken at the laboratories in Birmingham, as well as those demanded by members. They may therefore be regarded as authoritative. The methods are clearly described, and with only sufficient detail for the guidance of competent analysts. Some useful hints, such as a reference to the presence of manganese in asbestos wool used for filtration, are to be found in the text. A closing section is concerned with the polishing and etching of specimens for microscopical examination. This might be improved in some details. Recent American workers have shown how slight modifications of technique greatly increase the truth of rendering of the graphitic constituents. White metal for embedding irregular specimens is greatly inferior to bakelite in powder form, which has no electrolytic action and is easily applied.

Astronomical Topics

A Star occulted by Jupiter. Mr. A. Burnet has for some years predicted occultations of stars by the planets. He lately predicted the occultation of the ninth magnitude star B.D. 8°, 2456 by Jupiter, which was visible in the United States on the night April 20–21. A Science Service bulletin of April 29 reports that the phenomenon was observed and photographed at the Yerkes Observatory. The director, Prof. O. Struve, sent copies of the photographs to Science Service. It is stated that they show the approach of the star to the planet; on the last photograph it is nearly in contact with the limb. The four large satellites also appear on the photographs. Planetary occultations of stars are not very common. On one occasion a sixth magnitude star was occulted by Jupiter, and with the large reflector at Melbourne the star remained visible for some distance within the limb of the planet. Stars have also been seen to remain visible when passing behind Saturn's ring.

Recent Observations of Mars. The March issue of the *Journal of the British Astronomical Association* contains a preliminary report of the work of the Mars Section, by its director, Dr. R. L. Waterfield. Midsummer of the northern hemisphere occurred on April 10; rapid shrinking of the north polar cap occurred; Olympia became separated from the cap on March 12, and Lacus Hyperboreas appeared as a dark spot on the snow-line on March 22. Another rift across the cap was seen at the end of March in longitude 300°. The northern maria, Casius, Propontis and Acidalium were very dark. The southern maria were pale, presumably owing to mist over them. The two bright bridges across Acidalium, known as Baltia and Achillis Pons, were very bright, as was also Herculis Pons. Margaritifer Sinus was shorter than usual, and had a blunt north end, instead of the usual point. Solis Lacus, which changes much in appearance at different oppositions, was small, pale and difficult to see. The canals Ganges, Euphrates, Hiddekel and Gehon were not seen early in the apparition, but reappeared at the end of March. A sketch by Mr. Hargreaves shows Nilokeras doubled.

Comets. Circulars from New Zealand appear to indicate that the comet Dodwell-Forbes was independently discovered there; the name of the discoverer is not stated. It was at first suspected to be Tempel's comet of 1866, but this was soon disproved by its motion. It is, however, moving in an elliptical orbit; the two following orbits have been recently published, based on an arc nearly two months long: the equinox is that of 1933·0.

T	1932 Dec. 30. 52167 U.T.	Dec. 30. 51633 U.T.
ω	327° 20′ 4·2″	327° 19′ 40·8″
Ω	77 40 21·7	77 38 54·5
i	24 30 3·6	24 30 33·0
e	0·972064	0·973560
q	1·130720	1·131018
Period	257·5 years	279·9 years
Computer	H. Hirose	A. D. Maxwell
Reference	*U.A.I.Circ.* 429	*Pop. Astr.*, March

Peltier's comet shows no deviation from a parabola; the following orbit was derived by Mr. Möller from observations up to February 28, and satisfies observations made a fortnight later (*U.A.I. Circ.* 428):

$$\begin{array}{ll} \mathrm{T} & 1933\ \text{Feb. } 6.\ 689\ \text{U.T.} \\ \left.\begin{array}{ll} \omega & 135^\circ\ 58'\ 41'' \\ \Omega & 311\ \ 31\ \ 51 \\ i & \ 86\ \ 40\ \ \ 5 \end{array}\right\} & 1933{\cdot}0 \\ q & 1{\cdot}00060 \end{array}$$

Comet Schwassmann-Wachmann is now in aphelion; it passed perihelion on 1925 May 15, two years before its discovery; its period is 16·3 years, so aphelion passage will be early next July. In spite of its great distance it is still showing activity; a remarkable brightening up at the end of last year was noted both at Bergedorf and at Yerkes. It is probably more massive than most comets.

Recent Developments in Coal-Mining Explosives

IN British mines, about thirty million pounds weight of explosives are used annually. This involves the firing of about sixty million shots. When any shot is fired there is potential danger, particularly in gassy mines. Recent improvements in coal-mining explosives have aimed at increasing both their safety and efficiency. The three main developments have been (1) low-freezing explosives, (2) low-density explosives, and (3) 'Cardox'.

In a paper read recently before the Midland Institute of Mining Engineers, Dr. W. Payman, chief chemist to the Explosives in Mines Research Committee, discusses these developments. Nitro-glycerine freezes at 13° C. (55° F.) so that during storage in cold weather all explosives containing it become solid. Consequently many attempts have been made to render nitro-glycerine explosives non-freezing. The first method adopted in Great Britain was the substitution of a portion of the glycerine used in the manufacture of nitro-glycerine by polyglycerine. Though quite effective, this has now been replaced entirely by nitro-glycol. Polyglycerine was difficult to make and was not of constant composition. Glycol resembles glycerine in many respects and is largely used for preventing freezing in motor-car radiators. The efficacy of the use of low-freezing explosives is indicated by the fact that no fatal accident due to handling hard or frozen explosives has been reported for several years.

Low-density explosives have been developed mainly to reduce the shattering effect of high explosives and to increase the yield of lump coal. The average density of the new low-density explosives is about 0·7, whereas that of the older explosives is 1·0; their respective weight-strengths, however, as judged by Government tests, are about the same. The decrease in density has been brought about by the incorporation with the explosive of bulky wood sawdust or plant fibre. The reduced shattering effect of the low-density explosive appears to be due mainly to the spreading of the direct action of the explosive on the coal.

The introduction of 'Cardox' is one of the outstanding contributions to safety of recent years. The 'Cardox' blasting device consists of a strong steel shell containing a charge of liquid carbon dioxide and a heating element which converts the liquid carbon dioxide almost instantaneously into gas at high pressure. The pressure produced is sufficient to shear a disc at one end of the shell or cartridge, when the gas escapes and exerts a disruptive effect on the surrounding strata. The advantages claimed for the 'Cardox' blasting device are: (1) increased safety in the presence of firedamp and in handling; (2) increased yield of lump coal; (3) easy recovery of misfires; (4) little disturbing effect on roof near the shot-hole; and (5) absence of fumes.

It is encouraging to learn that the merits of the 'Lemaire sheath' are at last being given the serious attention of the Safety in Mines Research Board. This safety device consists of a thin cylinder of plastic clay mixed with sodium fluoride or another agent or both; the clay cylinder or 'sheath' envelops the explosive and largely damps out the flame resulting from its detonation. The Lemaire 'safety sheath' has been officially adopted in Belgium for many years.

Radio Direction-Finding

AT a meeting of the Wireless Section of the Institution of Electrical Engineers held on April 5, two papers were read describing recent research carried out at H.M. Signal School in the development of radio direction-finders for use in naval ships. In the usual form of direction-finder, it is customary to employ a figure-of-eight reception characteristic for taking the direction, and then, by a separate operation, to resolve the 180° ambiguity by determining the 'sense' of the bearing previously obtained. The ordinary cardioid reception characteristic employed for the latter operation is not suitable for determining the bearing to any great accuracy, so that the two operations are necessary, involving an increase in the time required to obtain a bearing.

In one of the papers, entitled "A Radio Compass Developed in H.M. Signal School", Messrs. C. E. Horton and C. Crampton described a system whereby both the direction and the sense are determined by a single operation. The system employs two rotating loops or frame coils fixed together at right angles; one loop is arranged to give a figure-of-eight characteristic while the other gives a cardioid, the two characteristics being combined in such a way that the minimum of the cardioid is coincident in direction with one zero of the figure-of-eight. The paper included an analysis of the behaviour of such a direction-finding system, when installed in a steel ship, and also an account of experiments carried out to verify the results. It was shown that by a suitable arrangement of the circuits the errors in bearing due to currents set up in the ship itself can be reduced to the values obtained with the equivalent simple direction-finder in the same position.

The second paper, by Mr. J. F. Coales, comprised a calculation, with subsequent experimental measurement, of the magnitude of the errors experienced on a ship's direction-finder due to the shape and orientation of the aerial at the transmitting station. The experiments were carried out in a light cruiser, with a destroyer as the transmitting ship. The aerial on the latter was of the inverted 'L' type, and errors of 1° or 2° were found in the calibration of the direction-finder, when the receiving ship was not in line with the horizontal portion of the transmitting aerial. This error decreased rapidly with increasing distance between the two ships, becoming negligible at about four miles. A knowledge of this error is important in carrying out a calibration of the direction-finder at very short distances, and it is desirable to take two sets of readings, with the transmitting ship steaming round the receiving ship, first in a clockwise, and then in an anticlockwise direction. The mean of the readings so obtained will form a true calibration of the direction-finder for signals arriving from a distance.

Investigations on Timber

UNDER the auspices of the Department of Scientific and Industrial Research, the report of the Forest Products Research Board for the Year 1931 has been issued. It is combined with the report of the Director of Forest Products Research for the same year.

The investigations carried on during the year fall roughly into three groups: (1) the dry rot investigations being carried out in the new experimental building erected for the study of this subject, (2) investigations into the death-watch beetle and into the damage caused by the *Lyctus* powder-post beetles, and (3) investigation work on Empire timbers, more especially in the tropical hardwoods. Under (3), the report of the Research Board has some pertinent remarks on the subject of encouraging and organising the placing of Empire tropical timbers on the markets. Several of the points discussed have been already alluded to in NATURE (129, 696, May 7, 1932).

The report describes improvements in the design of seasoning kilns, new apparatus for the determination of humidity in the kilns, and a method of employing the photoelectric cell in the study of wood structure by using it to measure the percentage of empty space in the interstices of a timber due to its cell structure. Apparatus is also described which determines the gloss of a machined surface by measuring the amount of light scattered or reflected from it. Another instrument measures the finish on a surface by recording the frictional resistance experienced by dragging a standard metal plate over the surface.

The report emphasises the importance of research on wood-working tools. "A new Empire timber is often condemned by the machinist as 'unworkable' simply because machines, developed to deal with timbers in common use, are not suited to the very different structure of the new timber. A modification of feed speed, cutting speed or cutting angle may be all that is necessary to make the most obdurate timber workable, but in order to foretell these modifications a knowledge of the way in which the cutting action of any tool, whether plane, saw or drill, should be related to the structure of the wood on which it is to work is essential."

During the year, 689 specimens of structural timber were tested, while 3,470 test pieces cut from a material free from knots, etc., were submitted to almost every conceivable mechanical test. Tests on physical properties, etc., numbered more than 9,500. A total of 4,800 specimens treated in various ways with eight wood preservatives, including low temperature tar and its distillates, have been exposed for test and are kept under constant observation.

Antarctic Geology and Glaciation [*]

THE sub-antarctic islands south of the Indian Ocean—Prince Edward and Marion Islands, the Crozet Islands, St. Paul and Amsterdam Islands, the Kerguelen Archipelago, and Heard Island—are all of the character of oceanic islands. So also is Macquarie Island in the Australian sub-antarctic. They are the summits of vast igneous extrusions heaped upon the sea floor. Volcanic activity has ceased only in recent times. Hot springs are still met with at St. Paul and have been vaguely reported from Kerguelen Island. All those islands in higher latitudes than 40° S. show evidence of severe glaciation during geologically recent times. Glaciers are still a feature of Kerguelen Island, Heard Island, and the Crozets. As a consequence, morainic debris, fluvial sands, and peat beds occur irregularly distributed over their surface.

Magmas contributing to the formation of these islands are, in the main, very basic. Varieties of peridotite, basanite, and basalt have been extruded on a vast scale. Next in order of abundance but subordinate in quality is an interesting range of trachytes and phonolites. Coarse tuff beds on Macquarie Island, Heard Island, and Kerguelen contain fragments of a dense, recrystallised *Globigerina* ooze, indicating that the igneous outbursts have broken through pelagic sediments. The occurrence of unsaturated magmas amongst the volcanic effusions may be attributable to the assimilation of quantities of such calcareous oozes.

Acid lavas are scarce, the only notable record so far being the appearance of rhyolite amongst the earlier eruptive debris of St. Paul Island.

Macquarie Island is unique amongst these localities in exhibiting some of its basic igneous rocks in an advanced state of serpentinisation. There, also, are found former submarine volcanic centres where tachylite now considerably palagonitised was extruded.

Kerguelen, which is much larger than any of the other islands under consideration, also reveals a more complicated geological structure. This appears in the deep fjords, where sections are exhibited cut down through several thousand feet of strata. In the south-western portion of the island, there are thus brought to light plutonic rocks such as monzonite, mica-diorite, and even syenitic types. These have doubtless originated, as Lacroix has explained, by injection into the already solidified effusive lava system.

Chronological evidence is limited and is so far found only at Kerguelen. There, a land surface composed of igneous rocks, basalts, trachytes, and the like, appears to have been in existence in early Tertiary times. Upon this surface, fluviatile conglomerates were laid down on a grand scale. These incorporate in their upper limits irregular intercalations of lignite. The fossil vegetation recorded is dominated by an Araucarian flora very similar to that existing to-day in the considerably warmer climate of Norfolk Island. The age of this lignite is likely to be late Oligocene.

Thereafter follows a vast succession of basalt flows and ash beds, high up in which series has been located a band of coarse littoral sediment rich in fossil mollusca with a Pliocene facies. The mollusca, by their nature, indicate water warmer than prevails to-day along those shores. Further volcanic outpourings both basic and trachytic conclude the series.

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[*] Substance of a lecture entitled "Geology and Glaciation of some Islands of the Southern Ocean and the newly discovered Antarctic Mainland" delivered by Sir Douglas Mawson at the Geological Society of London on May 10.

Then came the glacial period. Almost the entire land area became buried under ice. Only now is Kerguelen emerging from a period of profound glaciation, which re-moulded pre-glacial topography and has yielded an outstanding example of fjord and skerry development.

To turn now to the antarctic regions nearer the pole. It has been shown that southward of Australia and the Indian Ocean there exists a continuous, circumpolar, continental bulge. This has been delineated in the neighbourhood of the antarctic circle through 3,000 miles of arc. Thus, for the first time, it is demonstrated that under the antarctic ice there lies a continent and not merely scattered islands holding together an ice mass. Everywhere around this great sector the rocks outcrop on the coast; also those ice-borne from the land and shed on the sea floor are continental in type. The antarctic land south of the Indian Ocean is characterised by rock forms typical of the deeper continental sub-strata, such as varieties of granite, norite, and charnockite; also gneisses and schists in which garnet, cordierite, and sillimanite figure abundantly.

Though most of this land region is smothered beneath an ice cap, continental in dimensions, yet there is clear evidence that the intensity of glaciation has greatly diminished since the peak period. There seems no reason to doubt that the latter coincided with the ice flood of the Pleistocene, recorded in the northern hemisphere. At the height of the glaciation, the continental ice cap extended everywhere to the margin of the continental shelf which, in the antarctic, is still unduly depressed, owing apparently to lag in isostatic readjustment after subsidence under the ice load. Submarine banks found distributed along its margin and elsewhere on the continental shelf indicate standstill periods of the ice front. Rock-floored, ice-scoured, moat-like depressions are a feature between the off-lying submerged banks and the present coast.

University and Educational Intelligence

BRISTOL.—The following appointments have recently been made: Dr. J. F. Baker, to the chair of civil engineering; Prof. A. E. Trueman, professor of geology in University College, Swansea, to the chair of geology; Prof. G. Hadfield, professor of pathology in the London School of Medicine for Women, to the chair of pathology; Mr. J. W. de Witt G. Thornton, lecturer in pharmacology; Mr. J. D. A. Gray, senior pathological officer in the Department of Preventive Medicine; and Mr. J. W. Edgell, dairy bacteriologist with the standing of an assistant lecturer in the University.

CAMBRIDGE.—The following have been appointed to University lectureships: Mr. R. F. Kahn, of King's College, in the Faculty of Economics and Politics; Mr. A. H. Wilson, of Emmanuel College, Mr. W. V. D. Hodge, of St. John's College, and Mr. P. Hall, of King's College, in the Faculty of Mathematics.

A vacancy exists for a University demonstrator in the Department of Mineralogy and Petrology, who will be required to teach crystallography and crystal physics. Applications should be sent to Prof. C. E. Tilley, at the Mineralogical Laboratory.

It has been recommended that the plans prepared by Mr. Redfern for an extension of the Chemical Laboratory be approved and that the tender of £3,360 received from Messrs. Coulson and Son Ltd. for the work be accepted.

Mrs. G. Stephenson has presented to the University a valuable gift of books from the library of her late husband, Dr. J. Stephenson. Some of these books have been added to the Balfour Library and some to the library of the Advanced Laboratory of Zoology.

ST. ANDREWS.—Mr. John Anderson, surgeon in Dundee Royal Infirmary and lecturer in clinical surgery in the University, has been appointed professor of surgery in succession to the late Prof. L. T. Price.

THE Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 has made the following appointments to senior studentships for 1933: on the recommendation of the University of Cambridge, Mr. E. H. F. Baldwin, for research in biochemistry; on the recommendation of the University of Edinburgh, Dr. H. W. Melville, for research in physical chemistry; on the recommendation of the Imperial College of Science and Technology, London, Mr. J. I. Armstrong, for research in plant physiology, and Dr. W. G. Penney, for research in physics; on the recommendation of the University of Oxford, Dr. B. K. Blount, for research in organic chemistry.

RURAL education in East Suffolk is in process of re-organisation along lines described in pamphlet No. 93 of the Board of Education (H.M. Stationery Office, pp. 40, 9*d*.). The new 'area' or 'senior' schools for children of 11–15 years of age, which are being set up in pursuance of a scheme prepared in 1929 for giving effect to ideals formulated in the Hadow report on the education of the adolescent, have already demonstrated how very materially their pupils may benefit, not only in the direct results of their instruction but also very obviously in health, deportment and confidence. Among salient features of the new regime is the spacious planning of the school premises. It is usual for an area school to possess or have the use of five or six acres, and this gives scope for developing "the conception of the school as a social unit, as nearly as possible a self-sufficing community, and of its site as an estate". Here is to be found the key to success in rural re-organisation; nor is it necessarily an expensive one, for the cost per place of the new schools has in no case exceeded £33. The lay-out has been left to the individual planning of the head teacher with assistance from the official organiser of gardening. Plans of a typical lay-out are appended to the pamphlet. Another important point is that the whole of the children's education is brought under one roof and under one direction. Instead of working in isolation not only from one another but also from the head teacher and class teachers, those who specialise in wood and metal work and domestic science find ample opportunities of close co-operation with the happiest results. Essential particulars are given of the arrangements for conveyance, school canteens, methods of dealing with the problem of individual differences, games and other physical activities. The pamphlet is well worth reading from cover to cover, not only by all concerned with rural education but also by all who value the welfare of rural England.

Calendar of Nature Topics

Egg-Laying and Incubation of Painted Turtle

From 1915 until 1928, J. T. Nichols collected seven records of the egg-laying of the painted turtle (*Chrysemys picta*) and these range from June 8 to July 17, the time of egg-laying in four of six cases recorded being between 4.30 and 5.30 p.m. Eggs laid about June 25, 1928, were carefully marked as to place, but were left undisturbed until it seemed very unlikely that they would emerge before spring even if by chance lack of frost permitted. On October 28 the nest was opened, disclosing 11 fully developed young turtles in a bunch with fragments of old egg-shells. They measured one to one and a half inches in shell length. It would appear that although the young of the painted turtle hatch in the autumn, they do not emerge from the ground until the following spring, differing in this respect from the young of the snapping turtle, which are to be found above ground in September.

Egg-Laying of the Leathery Turtle

The leathery turtle (*Dermochelys coriacea*), the largest of its kind, is more highly adapted for aquatic life than any other testudinate, and yet it is perhaps the most primitive of the group. Its breeding range is confined to about lat. 15° N. and 15° S. and during the months of May and June the majority of the females deposit their eggs upon some sandy shore. Leaving the sea at any hour of the night between 8 p.m. and 3 a.m., the turtle makes its way fifteen or twenty metres up the shore and there places her spherical soft-shelled eggs in a deep nest from which the young hatch after 58–65 days according to the intensity of the sun. In every nest of embryos examined by P. E. P. Deraniyagala there were two eggs containing twins. This author has made a very careful study of the development of the embryo and has found that the characteristic smooth-skinned condition of the adult results from the thinning out of the infantile scales which are not directly responsible for the corselet platelets (*Spolia Zeylanica*, **17**, 73 ; 1932). Nothing is known of the later development and growth of this turtle, of which the adolescent stage is unknown and appears to be spent far from land. The newly hatched young invariably sickened and died on a diet of fish. The morphological changes of the embryonic stages suggest a closer approach to the larval stages of Amphibia than is shown by any other living reptile. Apart from this feature, several of the adult characters, such as the clawless limbs, smooth skin, crested tail, skull characters, general build of the pelvis, and the cartilaginous nature of the skeleton, are reminiscent of the Amphibia.

The Painted Lady Migrates

In June the mass-movements of the painted lady butterfly (*Vanessa cardui*) reach their height in Europe. At the same time the migrations assume a new character which shows that mid-summer is for the painted lady the vague boundary which divides spring habits from autumn habits. Up to mid-summer, according to Dr. C. B. Williams, there is a prevailing tendency for the insect to move to the north and west, 94 flights in these directions have been recorded as against 59 in a southerly and easterly direction. In June, flights towards the south and east become more common and then predominate in July and August ; but although there is evidence of a definite movement northwards, there is no sound evidence of return migrations in autumn. The painted lady occurs in every continent of the world, yet their place of origin is still a little doubtful. In Europe the species does not survive the winter in numbers such as would give rise to large movements, and on account of the appearance of swarms entering Egypt and Algeria from the south, Dr. Williams surmises that the centre of dispersal lies somewhere south of the Sahara desert. His view is supported by the evidence of Skertchly, who in March 1869 saw emerging from their pupæ in grass in the Sudan, a cloud of painted ladies which was certainly more than a mile long and a quarter of a mile in breadth. The speed of migratory flight in this species appears to vary between 11 and 15 miles per hour whether with or against the wind, and a summation of the records suggests that there is probably no relationship between the direction of flight and the direction of the wind at the time.

American Pronghorn increasing in Numbers

In May or early in June the fawns of one of the oddest of horned ungulates are born, generally two at a birth, sometimes three. Although it resembles an antelope in appearance, the pronghorn (*Antilocapra americana*) is not closely related to the true antelopes of the Old World, and it is the only hollow-horned creature which sheds its horns every year. When white men first invaded the plains of western America, the pronghorn was more numerous than the bison ; but the spread of agriculture and grazing, and the gun, brought it a generation ago nearer to extinction than even that species. A campaign for the protection of the pronghorn has been most effective. A census just concluded by the New York Zoological Society gives the numbers (according to Science Service, Washington, D.C.) as approximately 68,000 in the United States and 2,400 in Canada ; whereas ten years ago, when the U.S. Biological Survey made a similar count, the numbers were 27,000 in the United States, and 1,327 in Canada.

Resistance of Turnips to Finger and Toe Disease

This is the turnip-sowing season in the north of England and in Scotland. In this connexion the experiments recently described by Prof. J. Hendrick of Aberdeen (*Trans. Highland and Agric. Soc. Scotland*, 1932, p. 52) with a variety of yellow turnip that is highly resistant to the 'finger-and-toe' organism, *Plasmodiophora brassicæ*, are of interest. For several seasons the Bruce, as the variety is now called, has produced good crops of usable quality on the well-known continuous turnip plots at Craibstone. Ordinary varieties of turnips are quite worthless on this heavily infected land. The control of finger and toe by liming is well understood, and represents one of the classic cases of the combatting of plant disease by modification of the soil reaction. Nevertheless, cropping with oats, potatoes and grass can proceed quite successfully on 'finger and toe land' and it may not be feasible or even desirable in all cases to undertake liming on such a scale as would cure the disease. A resistant variety offers a simple way out of the difficulty, and if the resistance of the Bruce is maintained, the variety should be a real contribution to the farming of acid soils in the turnip-growing districts.

Societies and Academies

London

Physical Society, May 5. N. R. Campbell: The measurement of visual sensations. The paper is a criticism of Dr. L. F. Richardson's proposed method of measuring sensations by 'mental estimates'. In the absence of agreed principles the discussion is conducted in the light of an analogy with thermometry. It is argued that if Dr. Richardson's facts and his implied propositions are true, indirect measurement by means of his *S* must be preferable to direct measurement by *R*. Arguments based upon the fact that this method of measurements leads to a numerical law between *R* and *S* would be valid only if the law is true and not empirical. If the method measures anything, that something is almost certainly not a sensation. Dr. Richardson's method indicates the theoretical possibility of a method of measurement based upon ordering differences of increasing degree; but there is no evidence that the method is ever practically possible. V. H. Stott: The measurement of the viscosity of a molten metal by means of an oscillating disc. It has been found necessary to calibrate the apparatus on molten metals having viscosities and densities not too different from those of the metals to be investigated. The viscosity of tin at different temperatures has been determined by Sauerwald and Topler by the capillary tube method, and the present experiments have lengthened the range of temperature for which the viscosity of tin may be regarded as fairly well established. Discontinuity in the (viscosity, temperature) curve of molten tin at temperatures near its freezing point is very improbable, and certainly does not occur at temperatures more than 6° C. above that point.

Dublin

Royal Dublin Society, Feb. 28. J. Carroll: Study of the potato eelworm (*Heterodera schachtii*) in the Irish Free State. The investigations include a study of the relationship between the parasite and the hydrogen ion concentration of the soil, and also a study of the relationship between the intensity of potato sickness symptoms and the number of eelworm cysts present in the soil. The experiments which were carried out, although of a limited nature, demonstrated satisfactorily that *Heterodera schachtii* can of itself give rise to severe symptoms of potato sickness, and that there is a positive relationship between the intensity of potato sickness and the number of cysts present. The paper also includes references to experiments on soil treatment and refers to other strains of the parasite which have been found in Ireland. H. H. Poole and W. R. G. Atkins: Some experiments on the suitability of photocells of the dry rectifier type for the measurement of daylight. Tests on these cells in intense illuminations show that the current illumination curves are rarely linear, their forms depending greatly on the resistance of the galvanometer employed. Temperature effects are important with some cells, and should be minimised by avoiding excessive exposure to strong light except for brief periods. Low resistance galvanometers are preferable as giving curves more nearly linear and less subject to temperature effects. A number of different cells were tested for their spectrum sensitivities, which were widely different according to the type of cell. The Bergmann cell is sensitive throughout the whole of the visible spectrum, its maximum being in the orange red. The permanence of this cell has not so far been tested, but all other cells tested have shown a fall of sensitivity with time and exposure. The cells appear to be well suited for rapid comparative measurements of daylight where great accuracy is not required.

Paris

Academy of Sciences, April 24 (*C.R.*, 196, 1177–1252). The president announced the death of R. de Forcrand de Coiselet, *Correspondant* for the Section of Chemistry. L. Cayeux: The rôle of the Trilobites in the genesis of the Palæozoic deposits of calcium phosphate. From the author's discussion it would appear that no important contribution of phosphate to Palæozoic strata can be attributed to Crustacea, especially Trilobites. Ch. Maurain: The interval of time between solar phenomena and terrestrial magnetic disturbances. Historical summary of published work on this subject. J. Costantin: Variations in the virulence of degenerescence in the potato. Discussion of the causes of resistance to disease. It is shown that the weight of crop per plant is a valuable criterion for determining the resistance to disease. M. Gignoux and L. Moret: The Briançonnais zone and the roots of the Savoy pre-alpine sheets. Mlle. Margherita Piazzolla-Beloch: A remarkable family of plane topological curves. Mlle. Marie Charpentier: Closed curves and their first ends. N. Botea: Holomorph functions. W. Stepanoff and A. Tychonoff: The spaces of nearly periodic functions. L. Pontrjagin: Nearly periodic functions and *Analysis situs*. Jacques Devisme: Two questions relating to the equation of P. Humbert. Antoine Appert: The rôle of the second condition of F. Riesz in abstract spaces and certain properties of connexion. Giovanni Lampariello: The analytical nature of the solutions of canonical equations integrable by quadratures. Robert L'Hermite: An indefinite plane piece submitted to the action of massic forces in the plane and the application to the calculation of rectangular drums supporting interior and exterior forces. J. Ellsworth: Remarks on the double system *RZ* Cassiopeiæ with eclipses. From an analysis of the known data the author concludes that contrary to the opinion of Hellerich, the photometric and spectroscopic data are not irreconcilable. J. J. Trillat and L. Leprince-Ringuet: Studies of the molecular phenomena at the surface of separation of oil and water. Applications to the control of oils. Changes in the surface tension at the oil water surface have been studied by Lecomte de Noüy's method, with special reference to the effects of traces of impurities in the oil. Proportions of impurities so small as 1/100,000 can be detected in this way. Jean Cayrel: A new detector. Studies in metal-crystal rectification. P. Lainé: The magnetic double refraction of liquid oxygen. The magnetic double refraction of liquid oxygen was found to be – 1·96 times that of nitrobenzene, slightly greater than the value found by Zernike (– 1·85). The dispersion was measured for three wave-lengths. Pierre Dubouloz: The yield of fluorescence of sodium salicylate. Studies of a potassium photoelectric cell coated with sodium salicylate. Applied to the photometry of the ultraviolet, it gives a convenient means of obtaining a very slightly selective receiver the sensibility curve of which is independent of the cell and its preparation. J. P. Mathieu: The alkaline tartaric solutions of chromium. Gaston Charlot: The catalytic oxidation of organic compounds in the form of vapour. P. Mondain-Monval and Roger Wellard: The direct oxidation of acetylene by air. Acetylene reacts with air at temperatures well below the polymerisation temperature, with production of peroxides. The peroxide is regarded as producing the spontaneous inflammation of detonating mixtures. A. E. Favorsky and J. N. Nazarow: The question of the existence of metal ketyls in the fatty series. André Meyer and Marcel Tuot: The dehydration of some tertiary alcohols by anhydrous copper sulphate. Anhydrous copper sulphate possesses the advantage over other dehydrating agents that, while giving good yields of pure ethylene derivatives, no isomerisation is produced. Raymond Hocart: The orientation of arsenolite and of senarmontite by mica. These minerals, sublimed on to a thin plate of mica obtained by cleavage, are oriented by the mica. H. Lagotala: The continental formation subjacent to the limestones of Niari (French Congo). The author regards the conglomerate formations studied as a continental formation of glacial origin, partially fluvio-glacial. N. Menchikoff: New data on the geology of the western Sahara. André Eichhorn: The supposed existence of centrosomes and of asters in the higher plants. The observations of Feng on *Lonicera* are not confirmed and another interpretation is given to his results. Vladesco: The development of the octants in the embryo of the leptosporangiate ferns. R. Quetel: The variations of the proportion of nitrogen in the lilac in the course of forcing. Study of the effects of exposure to ether vapour followed by placing in a moist, warm atmosphere. J. Verne and C. Sannié: Study of the toxic action of cations on fibroblasts cultivated *in vitro*. P. Ponthus: The action of an ultra-violet radiation on aqueous solutions of gelatine. Modifications of some physico-chemical characters. Probable photolysis. F. Rathery, Mme. Andrée Plantefol and Lucien Plantefol: The reactions of the respiratory exchanges resulting from the ingestion of glucose and of insulin in diabetics.

Rome

Royal National Academy of the Lincei, Jan. 8. F. Severi: The compatibility of systems of algebraic and analytical equations. C. Carathéodory: Generalisation of a theorem of Euler on brachistochrone movement. E. Almansi: Deformations of elastic plates (3). P. Aloisi: An andalusite twin. The crystal here described was found on Mount Perone (Elba) and represents the only case of twinning in andalusite. The twinning plane has, however, the simple symbol {101}, which is one of the few known forms of frequent occurrence in andalusite, and the various optico-crystallographic elements are arranged regularly in the positions proper to a twin on {101}. C. Agostinelli: Concurrent directions in a variety V_n. Study of the notion of concurrent directions, introduced by Myller (1928), by vectorial methods furnishes the conditions of concurrence in a very simple form and allows of the deduction of various noteworthy geometrical properties not previously recorded. S. Amante: Reduction of a special class of matrices to canonical form (1). L. Campedelli: Certain invariant series of groups of points on a surface. Ruy Luis Gomes: Linear operators: limited matrices. E. Gugino: Transport by parallelism along a closed circuit in a Weyl space. M. Kourensky: Integration of the equations to the partial derivatives of the second order with two functions of two independent variables (5). Systems containing two (or one) derivatives of the second order. S. Minetti: A general theorem on the succession of functions converging towards a holomorphous function. Maria Pastori: Tensorial aggregates generated by absolute Pascal-Vitali systems: relation to the derived aggregates. Emma Senigaglia: Complement of a theorem of A. Hurwitz on the basis of the modulus of the algebraic forms passing through a normal rational variety. D. Bonvicini: The second variation of the elastic potential in isotropic solids. An expression, sufficiently approximate for investigating the stability of the equilibrium, is derived for this variation. G. Lampariello: The quadrature which effects the integration of canonical systems with one degree of freedom. L. Sona: Forced viscous rotations. A. Weinstein: Wakes caused by circular arcs. F. Zagar: Increase in the mass of a planet by cosmic dust. (2) General case. A. Quilico and A. di Capua: Aspergillin, the pigment of the spores of *Aspergillus niger* (1). Of various media tried, molasses–agar gave rise to most abundant fructification of the mould. The Pollacci strain gave spores containing more than 24 per cent of aspergillin, whereas with a strain isolated from Abruzzian cheese the content did not exceed 15·6 per cent. Yields of aspergillin of 0·24–0·34 gm. and 0·10–0·22 gm. per square decimetre of medium surface were obtained; these may be increased considerably by removing the mycelium as well as the spores. R. Gigante: Preliminary investigations on a non-parasitic alteration of the olive. During last season the olives of Latium frequently developed slightly depressed greenish-brown spots of diameter 1–6 mm., which afterwards darkened. These were not the result of photolytic processes, deficient transpiration, or insect punctures, but appear to have been caused either by insect secretions or by fungicides having a molasses basis.

Vienna

Academy of Sciences, Jan. 27. Herbert Schober: The spectra of rhenium (4). Arc spectrum in the ultra-violet region on copper electrodes between 2400 and 4000 A. In the ultra-violet, more than 1800 lines have been identified in this spectrum, so that the total emission of rhenium in the copper arc between 8000 and 2400 A. shows about 3000 lines. The measurements agree well with those made simultaneously by Meggers at the American Bureau of Standards. Herbert Haberlandt: Luminescence investigations with fluorites (2). The occurrence, at Alland in Lower Austria, of a fluorite with a natural red photo-luminescence, is recorded. In general, the luminescence of fluorites is intimately connected with the paragenetic relations. Thus, in one case, it must be ascribed to the rare earths present and in another to bituminous impurities. Ludwig Lämmermayr: Comparative studies on the plants of eastern Styrian basalts and basaltic tufas (3). Ernst Nowack: The geological relationships of the region between Eregli and Bolu (Northern Anatolia). Gustav Götzinger and Helmut Becker: Stratigraphy of Wienerwald-Flysch east of Traisen.

Feb. 2. Guido Machek: Action of gaseous cyanogen on phenols and naphthols. (2) Dicyanogen and trihydroxybenzenes. (3) Dicyanogen and certain naphthols. The cyanisation of pyrogallol, β-naphthol, 2 : 3- and 2 : 7-dihydroxynaphthalenes proceeds with formation of molecular compounds. With phenol and hydroxyquinol, no individual products could be obtained, and phloroglucinol, α-naphthol, 1 : 3- and 1 : 4-dihydroxynaphthalenes did not react with cyanogen. **HANS PETTERSSON** and **JOSEF SCHINTLMEISTER**: Atomic fragments of short range from heavy elements. A new method of procedure is applied to the heavy noble gases, etc. **GERHARD KIRSCH** and **ROBERT TRATTNER**: Atomic disintegration with emission of neutrons. Of a number of elements subjected to irradiation with polonium α-particles, boron alone gives a number of neutrons comparable with, although smaller than, that yielded by beryllium. When tested by the Wilson method, the elements Li, C, N, Mg, Al, S, Fe, Cu, Zn, Pd, Ag, Sn, W, Pt, Au and Pb give definite but small effects, which are about 1 per cent of that obtained with beryllium. Molybdenum and nickel give effects of a lower order of magnitude and possibly emit no neutrons. With platinum and palladium, the effect has been confirmed in other ways (Geiger counter and photography) by measurement of the secondary absorption. **LUDWIG SELTENHAMMER**: Stability of the frame-rod arranged with parallel edges and compressed centrally. **KARL FRITSCH**: Observations on flower-visiting insects in Styria, 1913. Pollination of *Draba verna* L. is effected mostly by small species of the genus *Halictus*. With *Prunus*, the size of the pollinating insect conforms to that of the flowers; thus *Prunus spinosus* L. is visited more especially by small aphids, such as *Halictus* and *Andrena* species, and *P. avium* L. often by *Bombus* species. The names of various insects, not previously observed as pollinating insects in Styria, are given.

Forthcoming Events

Monday, June 12

VICTORIA INSTITUTE, at 4.30.—Sir Ambrose Fleming: "Free Will versus Determinism" (Presidential Address).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—T. H. Harrisson: "The Oxford University Exploration Club's Expedition to Sarawak".

Thursday, June 15

ROYAL SOCIETY. Discussion on "The Experimental Production of Malignant Tumours" to be opened by Dr. J. A. Murray.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15.—Annual General Meeting. Lieut.-Col. H. W. Aston (Director of School of Tropical Medicine and Hygiene, Calcutta): "Carriers of *Entamœba histolytica* and their Treatment".

Official Publications Received

GREAT BRITAIN AND IRELAND

The University of Leeds: Department of Coal Gas and Fuel Industries (with Metallurgy). Report of the Livesey Professor (John W. Cobb) for the Session 1931–32. Pp. 12. (Leeds.)

Proceedings of the Royal Irish Academy. Vol. 41, Section A, No. 7: The Influence of Condensation Nuclei and Dust Particles on Atmospheric Ionisation. By P. J. Nolan. Pp. 61–69. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

The Himalayan Journal: Records of the Himalayan Club. Edited by Kenneth Mason. Vol. 5. Pp. vi+iv+168+25 plates. (London: Oxford University Press.) 8*s*. net; 5 rupees.

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 3, No. 22: Studies on the Scottish Marine Fauna; the Natural Faunistic Divisions of the North Sea as shown by the Quantitative Distribution of the Molluscs. By A. C. Stephen. Pp. 601–616. 2*s*. Vol. 57, Part 3, No. 23: The Diurnal Incidence of Disturbance in the Terrestrial Magnetic Field. By Dr. A. Crichton Mitchell. Pp. 617–632. 2*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Journal of the Society for the Preservation of the Fauna of the Empire. New Series, Part 19. Pp. 97. (Hertford: Stephen Austin and Sons, Ltd.) 2*s*. 6*d*.

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. Four Addresses on the Improvement of Grass Land. By Prof. R. G. Stapledon. Pp. 50. (Aberystwyth.) 1*s*.

Mind and the Machine: a Lecture delivered at the League of Industry Easter Study School, Exeter College, Oxford, April 1933. By Dr. Leonard P. Lockhart. Pp. 14. (London: The League of Industry.) 2*d*.

OTHER COUNTRIES

Canada: Department of Mines: Mines Branch. Investigations of Fuels and Fuel Testing (Testing and Research Laboratories) 1930 and 1931. (No. 725.) Pp. 166. (Ottawa: F. A. Acland.)

Conseil Permanent International pour l'Exploration de la Mer. Journal du Conseil. Rédigé par E. S. Russell. Vol. 8, No. 1, Avril. Pp. 141. (Copenhague: Andr. Fred. Høst et fils.) 4.50 kr.

Madras Fisheries Department. Report on a Systematic Survey of Deep-Sea Fishing Grounds by S.T. *Lady Goschen*, 1928–29. By Dr. B. Sundara Raj. (Report No. 3 of 1930, Madras Fisheries Bulletin, Vol. 24.) Pp. 199–232. 12 annas. Administration Report for the Year 1931–32. By Dr. B. Sundara Raj. Pp. iii+88. 8 annas. (Madras: Government Press.)

Journal of Science of the Hiroshima University. Series A (Mathematics, Physics, Chemistry), Vol. 3, No. 2, March. Pp. 137–242. (Tokyo: Maruzen Co., Ltd.) 83 sen.

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 11, Part 1, March. Pp. 122+ii+18 plates. (Tokyo: Iwanami Shoten.) 2.00 yen.

Seismological Report of the Earthquake Research Institute, Tokyo Imperial University. 1932, Part 2 (July 1–September 30, 1932.) Pp. 13–18+plates 10–15. (Tokyo.)

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1932. (Publication 3213.) Pp. iv+96. (Washington, D.C.: Smithsonian Institution.)

N.Z. Department of Scientific and Industrial Research: Apia Observatory, Apia, Western Samoa. Annual Report for 1931. Pp. iv+96. (Wellington, N.Z.: W. A. G. Skinner.) 5*s*.

Reports of the Newfoundland Fishery Research Commission. Vol. 1, No. 3: Observations upon the Economic Biology of the Caplin (*Mallotus villosus* O. F. Müller.) By G. F. Sleggs. Pp. 66+2 plates. (St. John's: Newfoundland Fishery Research Commission.) 1 dollar.

Publications of the United States Naval Observatory. Second Series, Vol. 13: Results of Observations with the Nine-inch Transit Circle, 1913–1926; Observations of the Sun, Moon and Planets; Catalogue of 9989 Standard and Intermediary Stars; Miscellaneous Stars. By H. R. Morgan. Pp. iii+365. (Washington, D.C.: Government Printing Office.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 1933, No. 4, Avril. Pp. 139–186. (Prague: Regia Societas Scientiarum Bohemica.)

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Hors série. Résultats scientifiques du Voyage aux Indes orientales Neerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. Publiés par V. Van Straelen. Vol. 1: Introduction. Par V. Van Straelen. Pp. 222+91 plates. (Bruxelles.)

Council for Scientific and Industrial Research. Pamphlet No. 37 (New South Wales Department of Agriculture, Science Bulletin No. 40): The Sheep Blowfly Problem in Australia. By the Blowfly Committee. Pp. 136+6 plates. (Melbourne: H. J. Green.) 1*s*. 6*d*.

Memoirs of the Punjab Irrigation Research Institute. Vol. 4, No. 4: The Use of the Antimony Electrode for determining Soil Reaction. By Dr. Amar Nath Puri. Pp. 11. (Lahore: Government Printing Office.) 5 annas; 6*d*.

Report of the Director of the Royal Observatory, Hong Kong, for the Year 1932. Pp. 9. (Hong Kong.)

Annual Report of the Imperial Council of Agricultural Research for the Year 1931–32. Pp. 39. (Calcutta: Government of India Central Publication Branch.)

The Indian Lac Research Institute. Bulletin No. 15: Notes on the Use of *Schleichera trijuga* (Kusum) in Lac Cultivation—Pruning and Cropping. By Dorothy Norris. Pp. 19. (Nankum.) 1.4 rupees.

Conseil Permanent International pour l'Exploration de la Mer. Faune ichthyologique de l'Atlantique nord. No. 12. 24 plates. (Copenhague: Andr. Fred. Høst et fils.) 4.00 kr.

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 22, No. 1, March. Pp. 199. (Tokyo and Sendai: Maruzen Co.,)Ltd.

The American Museum and Defeatism. Sixty-fourth Annual Report of the Trustees for the Year 1932, The American Museum of Natural History. Pp. vi+130+11 plates. (New York City.)

CATALOGUES

Livogen (Liver Extract with Vitamin B and Hæmoglobin). Pp. 4. (London: The British Drug Houses, Ltd.)

Installation and Maintenance of Instruments. Pp. 4. Thermometric Lag. Pp. 16. (London: Negretti and Zambra.)

Philips Industrial X-ray Service. Pp. 20. (London: Philips Metalix.)

Catalogue of Secondhand Books on Anthropology, Botany, Entomology, Evolution, Ornithology, Zoology, General Natural History, etc. Pp. 40. (London: W. and G. Foyle, Ltd.)

Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Orient et à l'Amérique. (No. 24.) Pp. 159–248. (Paris: Libr. Adrien-Maisonneuve.)

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Nationalism and Academic Freedom

GERMANY, responding to the call of a patriotic emotion—as she has more than once before, but never with such abandon—would appear to have handed herself over body and soul to Herr Hitler. Acting on a given view of history and a prescribed theory of racial and national regeneration, she seeks to purge herself of elements felt to be inimical or to stand in the way of the realisation of his ideal. A new communism, imposed by force, but accepted widely if not yet universally, with an enthusiasm which appears to have crossed the bounds of fanaticism, bids fair to reduce the whole of Germany as nearly as is humanly possible to one common denominator and to block every angle of vision but one in her political and intellectual kingdoms alike.

Both historian and anthropologist may look askance at the Hitlerian view of racial history and psychology as suspect in origin. They may dismiss with a smile the 'Aryan' claim to exclusive rights in the swastika. It is not the first time that ethnological facts have been 'edited' to bolster political aspiration or flatter national vanity ; nor will it be the last. If, in electing to remould herself as an 'organised State', Germany has chosen to rely on the hypnotic effect of a pseudo-scientific theory now exploded—an instrument which may break in her hand—that is her affair and concerns no one but herself. In expelling from public life those who, on racial or political grounds, are regarded as beyond the pale, Germany, by her own act, deprives herself of the services of some of her most eminent intellectuals. These are men prominent in the arts and sciences, in public life, in the professions and in education, who have raised and maintained her in the foremost ranks of intellectual achievement among the nations. This may well seem a blunder, at which the whole civilised world stands aghast, a misreading of history and a fatal misinterpretation of the conditions of progress in a modern society, in which, in these days of fierce competition, every resource of science is pressed into the service of social and commercial advancement. Yet even such action as this, although it has its international aspect, as a domestic matter, it is held, does not concern the outside world. But in forbidding men of German nationality, who have served their country loyally in peace and war, to exercise their talents, and in depriving them of the means of livelihood, Germany has been guilty, in the eyes of the world, of an act of grave injustice, which has made intellectual companionship with her difficult.

It is fully in accord with the tradition of religious and political liberty in Great Britain that the first attempt on a comprehensive scale to organise a scheme of assistance for the scholars, men of science and university teachers who have been forced to relinquish their posts in Germany should have been made by their British colleagues. It was never in doubt that, for men of the first rank and of international fame, room would be found without delay in the universities of other countries. This belief has been justified by the event. It did not seem likely that it would be possible in the normal course for academic institutions outside Germany, however great their goodwill, to absorb more than a few of those of less outstanding repute, and that too, perhaps only after some considerable delay. The difficulties are enormously increased by financial conditions, collective and individual, in the academic institutions of all countries alike. In teaching and research, competition for appointments at the moment is intense; and it would be neither fair nor practicable for a 'most-favoured nation clause' to be extended to displaced German teachers and research workers; while the requirements of the normal development of university work are such that it is unlikely that many universities would feel justified in making special provision for them. As the result of inquiry, it would appear that this is only too just an estimate of the position. Appointments will be available for only a small fraction of those in need.

It is in view of considerations such as these that, as already noted in NATURE (June 3, p. 793), the Academic Assistance Council has been organised. A provisional council has been formed which has issued a statement of the aims and methods to be followed, should the necessary support be received. The Academic Assistance Council will act in a double capacity. In the first place it will serve as a centre of information and as an organisation which will put the teachers concerned into touch with the institutions where they can work; and secondly, it will seek to raise a fund to be used primarily, though not exclusively, in providing maintenance for displaced teachers and finding them a chance of work in universities and scientific institutions.

There are several points arising out of this appeal which call for comment. Of these the most considerable is the effect of German action on science at large. While Germany may claim as a matter of domestic concern to lay down such regulations for appointments in and admissions to her academic institutions as she may deem fit, apart from all questions of justice it is a matter of concern to the whole scientific world that a number of workers, now considerable, be they Jews, or members of any religious or political group whatsoever, are deprived of the opportunities they have hitherto employed in adding to the sum total of scientific knowledge—researches by which ultimately the whole world has benefited, irrespective of nationality. It requires no special pleading to show that while Germany persists in her present attitude towards Jews and other men of science within her jurisdiction who do not conform to type, it is of advantage to the whole scientific world and an international obligation to ensure that everything possible is done to secure the continued benefit to science of the services of these displaced workers. The international appeal of the situation and the need for international action has not been overlooked by the provisional council. It is in relation, not merely with British universities, but also with bodies formed for a purpose similar to its own in other countries.

Unfortunately, the situation in Germany is not unique; and the Council proposes to utilise any funds entrusted to it for the purpose of assisting university teachers and scientific workers of whatever country who on grounds of religion, political opinion or race are unable to carry on their work in their own country. There is no doubt, however, that for the moment the situation in Germany is the most critical. The appeal records the names of a long list of teachers who have been dismissed, have resigned on account of student action, or are on enforced leave. Yet long as it is, it is confined to professors, extraordinary professors and *Privatdozenten* in institutions of university rank, and is stated to be incomplete.

It should be no matter for surprise that, while the appeal has been received with much sympathy, it has aroused misgiving, in view of the financial situation and the difficulty of finding appointments for trained scientific men, many with high qualifications, from our own universities and places of higher education, while among school teachers the position is equally, if not more, grave. Obviously it would be far from politic, and indeed unfair to the displaced teachers and research workers, to offer them posts in a market which is already overstocked. The Academic

Assistance Council has shown itself fully alive to the situation. Its proposals will, it is understood, take the form that any funds raised should be devoted to the creation of special posts and lectureships *ad hoc*, and that these will be of limited duration, a term of years at the end of which it may be anticipated that a process of adjustment will have worked itself out.

The appeal of the provisional council, of which Sir William Beveridge and Prof. C. S. Gibson act as secretaries, has already received a substantial measure of support. Office accommodation has been placed at the disposal of the Council by the Royal Society, and the appeal carries the names, among others, of Sir Frederick Gowland Hopkins, president of the Royal Society and of the British Association, Lord Buckmaster, Lord Cecil of Chelwood, Lord Crawford and Balcarres, Sir William Bragg, Mr. H. A. L. Fisher, Sir George F. Hill, director of the British Museum, Sir Frederic Kenyon, Mr. J. M. Keynes, Lord Lytton, Dr. Allen Mawer, Dr. Gilbert Murray, Lord Eustace Percy, Sir William Pope, Lord Rutherford, Sir Josiah Stamp, Sir J. J. Thomson, Sir Michael Sadler, Sir Charles Sherrington, and Prof. G. Elliot Smith.

The Development of Indian Thought

(1) *A History of Indian Philosophy*. By Dr. Surendranath Dasgupta. Vol. 1. Second impression. Pp. xvi+528. 30*s*. net. Vol. 2. Pp. xi+620. 35*s*. net. (Cambridge: At the University Press, 1932.)

(2) *Outlines of Indian Philosophy*. By M. Hiriyanna. Pp. 419. (London: George Allen and Unwin, Ltd., 1932.) 16*s*. net.

A COMPARATIVE study of Eastern and Western thought cannot but widen the understanding of philosophy as a collective effort to apprehend the ultimate sources of knowledge and life. It would also suggest to thinkers of either tradition, new methods of approaching these fundamental problems. A great deal of pioneer work still has to be done in both directions, in order to facilitate the accessibility and interpretation of the existing texts. The West has already published a large amount of original writings, critical editions and historical studies of its leaders of thought; but the East has the technical disadvantage of having entered rather late in the field of practical scholarship. Prof. Dasgupta tells us, for example, how the publication of the second volume of his great "History of Indian Philosophy" was delayed, among other reasons, by the fact that he had to read numerous unpublished and unknown texts, and to decipher patiently the handwriting of old and moth-eaten manuscripts.

Indian philosophy is so rich and complex, that it is impossible to estimate its progress without the help of an expert guide who would initiate one into the technicalities and intricacies of a difficult but most inspiring subject. We owe therefore a debt of gratitude to Prof. Dasgupta and to Prof. Hiriyanna, for their historical and exegetical efforts. Though their aims are different, their works are fully equal to their respective purposes. While Prof. Hiriyanna aims at no more than giving a well-balanced general outline of Indian philosophy, Prof. Dasgupta intends to give a detailed exposition of Indian thought strictly on the basis of the original texts and commentaries. Yet, they both follow almost the same order in their exposition, though Prof. Dasgupta is more patient about details, and gives one additional chapter of great interest on the conceptions of the Indian medical schools. The extensive bibliography in Prof. Dasgupta's two volumes adds to their scientific value.

One must go back to the sacred Vedas for the early sources of Indian philosophy. The Vedic gods, with their cosmogonic implications, must have been the first objects of independent thinking. Behind them, however, the concept of Brahman came to acquire a great significance as the supreme principle of everything. Yet the monotheistic tendencies thus developed, never displaced the ritualistic inclinations of the early Hindus, who cultivated diligently their polytheistic sacrifices. On the other hand, the law of Karma, which identifies sacrifice with action, implies a most effective causally related universe; so that the natural virtues attributed to the sacrifices lessened gradually the importance of deities as the supreme masters of the world and our fate. The ultimate unity of the universe soon gave rise to the idea of a world-soul (Atman), the highest essence in man as well as in the universe, which was to take such a great importance in the Upanishads. So far, it may be observed, the development of the early Vedic philosophy has a striking parallel in that of Greek philosophy, in which the gods of Homer had ultimately to give way before the urgent rational quests for the ultimate nature of things and for order in the universe, culminating in the recognition of a νοῦς by Anaxagoras.

The parallel develops further when we pass from the Vedas to the Upanishads. Just as it was the case when the centre of interest was displaced by Socrates from the outside world to the self, so, with the Upanishads, the attention of the thinkers is decisively focused on the self, instead of being directed to the Creator outside. This is a considerable change, though the Upanishads or Vedantas are believed to be the last portion of the Vedas. The fundamental idea which runs through the early Upanishads is that, underlying the external world of change, there is an unchangeable reality which is identical with that underlying the essence of man. The quest after Atman, with its many variations and implications, becomes the main concern of the philosopher. The post-Vedic writers have thus a good deal to say about the world, causation, the evolution of the soul and transmigration, and the final state of transcendental bliss which should be that of the soul when at the end of its inexorable cycle, conditioned by the all-pervading law of Karma. In spite of their unity of endeavour, all the Indian schools do not see eye to eye the possible answers to these problems. One of the reasons of the diversity of opinions is that the sutras of the sacred Brahmanic texts are mostly unfinished sentences the meaning of which has to be guessed rather than obviously stated.

These complications increased with the growth of Buddhism and Jainism, both schools outside the pale of orthodox Brahmanism. Though it is said that Buddhism derived much of its inspiration from the oral Samkhya and Yoga traditions of the Vedas, there is no doubt that it introduced entirely new conceptions into Indian philosophy. By denying the substantial and eternal Atman, Buddhism could not teach the conscious transcendental bliss which was the final state admitted by the Vedas. As our experience never apprehends the essence of things, but only our own perceptions, consciousness is nothing but a group of bodily and psychical states which, at death, disintegrate and merge into an unconscious nirvana. The main concern of Buddhism was the answer to the four 'noble truths': What is sorrow ? What is the cause of sorrow ? What is cessation of sorrow ? What can lead to the cessation of sorrow ? The whole of Buddhist doctrine is the development of the answers to these questions. The denial of a permanent external world and of a permanent soul leads to a complete upsetting of the major tenets of the Brahmanists about the unity, causality and purpose of the world and of life. It is interesting to note, however, that Buddhism had to develop a certain logic for its dialectic purposes. Thus we find in the Sautrantika theory of inference, that the Buddhist knew actually the doctrine of distribution of terms, of conversion, and of the hypothetical syllogism, during the third century before our era.

Jainism, on the other hand, took the opposite view about the world, admitting the permanence of the substance under the changing accidents, and identifying being as the union of permanence and change. This relative pluralism, as opposed to the extreme absolutism of the Upanishads and the extreme pluralism of Buddhism, was further emphasised by the Jainist doctrine of the 'nayas' or points of view in a judgment, which held that no truth is absolute but only conditional, and that the test of knowledge is that it helps us to attain our purpose—a striking anticipation of pragmatism.

These cross-currents in Indian philosophy influenced considerably the age of the systematic doctrines, as may be gathered from the conflicting opinions about the world, causation, perception, inference, the origin of knowledge and the rules of right conduct, put forward by the Samkhya and Yoga schools, the materialist conceptions of Carvaka-darsana, the Nyaya-Vaisesika philosophy, the Purva-Mimansa teaching, and the various Vedanta schools, such as the Sankara, Advaita and Visistadvaita traditions. In spite of their differences, these systems are remarkable products of rational thinking. Fine distinctions on logical problems, ontological and psychological theories, and ethical experiences and rules of conduct, illustrate the amazing versatility of the Indian mind and the sensibility of the Hindus. Translated into occidental language, these distinctions would no doubt prove quite capable of enriching the vast syntheses of our great thinkers. The qualified indications contained in the two works under review are already by themselves an ample mine of material for immediate use.

Before closing our remarks on the development of Indian thought, we wish to direct attention to the learned chapter on the "Speculations in Medical Schools" in the second volume of Prof. Dasgupta's work. Medicine was the most important of all the physical sciences in ancient India; and its conceptions are closely connected with such doctrines as the Samkhya and Vaisesika physics and the ethical teaching of the Vedic tradition. The earliest texts on medicine, which formed the basis of later commentaries, are those of the Atharva-Veda, which may have been composed by Brahma himself. In them, one finds a mass of information about the organs of the body, embryology, symptoms and observations of diseases, the use of medicines and charms, and, of course, a store of prayers, imprecations and hymns for the cure of certain diseases. Observations about the head, the heart, the circulatory and nervous systems are very important too, in so far as they have been taken as the basis of rival medical and psychological theories, such as the Tantras and the Caraka and Susruta schools, which give the spinal column and the heart, respectively, as the fundamental organs. There are also detailed speculations about the elements of the world and the elements of the body which, at times, bear a striking resemblance to the Hippocratic teaching and to that of the medical school of Crotona.

In conclusion, we can do no better than quote Prof. Hiriyanna's estimate of Indian philosophy (p. 24):

> "The two elements common to all Indian thought, are the pursuit of liberation as the final ideal and the ascetic spirit of the discipline recommended for its attainment. They signify that philosophy as understood in India, is neither mere intellectualism nor mere moralism, but includes and transcends them both. They have been represented as the two wings that help the soul in its spiritual flight. The goal that is reached through their aid is characterized on the one hand by illumination which is intellectual conviction that has ripened into an immediate experience, and, on the other hand, by self-renunciation which is secure by reason of the discovery of the metaphysical ground for it. It is pre-eminently an attitude of peace which does not necessarily imply passivity. But the emphasis is on the attitude itself or on the inward experience that gives rise to it, rather than on the outward behaviour which is looked upon as its expression and therefore more or less secondary. The value of philosophic training lies as little in inducing a person to do what otherwise he would not have done, as in instructing him in what otherwise he would not have known; it consists essentially in making him what he was not before. Heaven, it has been remarked, is first a temperament, and then anything else."

THOMAS GREENWOOD.

Research on Vitamins

Medical Research Council. Special Report Series, No. 167: *Vitamins; a Survey of Present Knowledge.* Compiled by a Committee appointed jointly by the Lister Institute and Medical Research Council. Pp. 332 + 12 plates. (London: H.M. Stationery Office, 1932.) 6*s*. 6*d*.

THIS book is both the most comprehensive and the most official of all publications so far available on its subject. It is the most comprehensive because it surveys all work up to the end of 1931, thus beating Sherman and Smith's monograph and Dr. Ethel Browning's vast compendium by several months; it is the most official because it is the only work on the subject, apart from its own earlier editions, that has been produced under the auspices of a government department.

To describe it, however, as a new edition of the earlier volumes is somewhat misleading; the revisions have been so exhaustive and the rearrangement in certain cases so fundamental as to make it a new work altogether. It is interesting to learn from the foreword that it is not proposed to revise it again or to publish any further editions. The reasons for this decision can best be given in the words of the Medical Research Council, which itself is responsible for issuing the report.

> "It can hardly be contemplated that the rapid and accelerating growth of the subject can be conveniently followed further by fresh revisions of such a monograph as this. The labour entailed and the sacrifices of time made by research workers in successive revisions of such a monograph are not likely to be justifiable again. The Council have joined with the Reid Library of the Rowett Institute, Aberdeen, and the Imperial Agricultural Bureaux Council, in giving financial support to a new periodical journal, "Nutrition Abstracts and Reviews", of which the first number appeared in October last [1931]. The Council hope that this will provide for the future a regular means of bringing together and making more readily available the results of research work as they accumulate in the now widely distributed and often disconnected fields of work, medical, agricultural, dietetic, and commercial, in which the subject of nutrition is being so rapidly developed."

Both the decision, and the reasons given for it, are symptomatic of the present condition of vitamin research. Not only has the subject become a recognised branch of biochemistry with repercussions in the extreme directions of pure chemistry and of applied medicine, but it is also just now at a stage when so many growing researches are about to blossom that it would be almost impossible to lay adequate plans for similar publications in the future. Indeed, the history of vitamin research since this book was published, and still more since the date of the latest publications included in the survey, give ample evidence on the matter.

During 1932 pure crystalline vitamin D became a commercial commodity: further advances have been made in investigating the nature of crystalline vitamin B_1, and the purity of the most concentrated specimens is probably little short of 95 per cent: highly concentrated preparations of vitamin A have now been made (see Carr and Jewell, NATURE, January 21, 1933, p. 92) of probably the same degree of purity as crystalline B_1, but unfortunately not themselves crystalline: Reader and her colleagues (*Biochem. J.*, 26, 2035; 1932) have announced the preparation of what may prove to be crystalline vitamin B_4: the identification of vitamin C with ascorbic (hexuronic) acid is now accepted by nearly all workers in the field.

It is clear that, as these researches reach fruition, investigation of the structure of each particular vitamin will cease to be a biochemical problem and will pass into the hands of the pure chemist. As soon as a vitamin becomes a definite, recognisable, and determinable entity—in the sense that accurate chemical measurement constitutes a determination while biological assay only constitutes an estimation—the hands of the physiologist and clinician will be immensely strengthened in their attempts to work out its precise metabolic function.

How much has already been achieved in this direction, in spite of the difficulties invariably confronting those who work with substances that can only be assayed biologically, is admirably told in this indispensable summary. Although in one or two places it may be possible to detect the individual views of well-known authorities, the objectivity of the volume as a whole is beyond reproach. Considering the fact that the actual text only occupies some 270 pages, its comprehensiveness is quite astonishing. It is, indeed, amusing to notice how often, on turning to the index to find a reference to some aspect of the problem that one thinks has been overlooked, one does indeed find a reference, or more than one, to that very aspect.

On certain matters the authors of particular sections have expressed themselves with refreshing definiteness. On page 69 we find it said that "There is no reason to believe that any of the toxic actions ascribed to cod-liver oil are due to its vitamin content". On page 122 it is stated that "The rat . . . requires for satisfactory nutrition four vitamins of this group, B_1, B_2, B_4, and factor Y: the pigeon at least three vitamins, B_1, B_3, and B_5". This is, incidentally, not a view that would be accepted by all those who have worked with the B complex; it is certainly held by some that the pigeon needs vitamin B_2. On page 227 it is interesting to read "About 500–1,000 c.c. (1–2 pints) of raw cow's milk provides enough or nearly enough of the vitamins A and C and of the B-vitamins of the yeast complex, but not enough of vitamin D. Cow's milk, however, is so variable in composition that this statement may need qualifying, and does not provide more than a slender basis for calculation".

It is perhaps legitimate to observe that cow's milk may here be suffering rather more from the amount of attention that has been given to it than from any fluctuation in the vitamin content of milk, as distinct from other foods. Probably far more samples of cow's milk have been assayed for vitamin content than any other single food-stuff, and it is not surprising to find very different results reported by different workers. It is at least conceivable that any other food substance that had been examined so often and in so many different parts of the world would show similar irregularities. The practice of arguing from the study of a particular sample of a particular substance that all other samples of the substance, wherever produced and under whatever conditions, will contain much the same amount of the vitamin as the sample examined, is all too prevalent in vitamin literature, and has led to generalisations as glib as they are fundamentally unsound and unconvincing. Nevertheless, it is gratifying to note the immense amount of information that is already available and only awaits co-ordination and extension to be made the basis of a really scientific consideration of world dietary problems.

The compilers of this report, owing perhaps to a modesty that we hope is characteristic of scientific workers in Great Britain, have a freedom from scientific chauvinism which is both rare and gratifying. The specialist in vitamin work has been irritated, at least as often as the specialist in other fields, by the production of books purporting to be objective studies of a subject, but found on inspection to be little more than a summary of their authors' own work and views. He has also been exasperated by books issued under titles promising comprehensive surveys of a whole subject, only to find that scientific workers of the author's own nationality must have been seriously under-rated by all the rest of the world, if the author's assessment of their work is to be regarded as correct. This volume is devoid of such faults. Naturally, American and British workers, who have indeed been first in many vitamin fields, receive most attention, but that this fact is not due to accidents of birth and language, is fully attested by the 26 pages of references at the end of the book. If English and American names, indeed, predominate here and in the text, German, Scandinavian and French names are to be found in plenty, supplemented occasionally by those of workers in many other countries.

It is, indeed, doubtful whether the book could have been made more comprehensive or freer from any suspicion of personal views and prejudices had it been produced by, say, the Health Organisation of the League of Nations. As it is, it carries just sufficient impress of the personalities compiling it to make it something very much more than an occasional reference book. For all those in any way interested in the development of the subject, it is a volume that not only must be read but will also be found to be very readable.

A. L. BACHARACH.

Membrane Equilibria

The Donnan Equilibria: and their Application to Chemical, Physiological and Technical Processes. By Dr. T. R. Bolam. (Monographs on Modern Chemistry.) Pp. vii+154. (London: G. Bell and Sons, Ltd., 1932.) 9*s.* net.

THE conditions of equilibrium in a system in which one component is unable to escape from the phase in which it is found, but is able to combine with another substance which can escape from the phase, were worked out by Willard Gibbs. The importance of equilibria of this type was not realised, however, until Donnan and Harris in 1911 described the behaviour of common salt when added to a system in which an aqueous solution of Congo red (the sodium salt of a complex sulphonic acid) was separated from pure water by a membrane through which the anion of the colloidal electrolyte could not pass. The concentration of sodium chloride was found to be greater in the solution which did not contain the colloidal electrolyte. Finally, a condition of equilibrium was reached when the product of the concentration of the sodium and chlorine ions, $[Na^+] \times [Cl^-]$, was the same on both sides of the membrane.

This type of 'membrane equilibrium' is of special importance in physiology, and was in fact described before the London Physiological Society in December, 1910. It is not necessary, however, that a membrane should be present, since similar conditions of equilibrium prevail whenever one ionic component of a pair of salts is prevented from diffusing freely. This non-diffusibility may be realised, for example, in a jelly, or it may be caused by adsorption at a surface.

The present volume describes, in a series of four chapters, the theory of the equilibrium, and its applications in chemistry, physical chemistry and biology. In addition to name and subject indexes, it contains a bibliography containing 143 entries. These include a few references to standard works on thermodynamics, etc., but are mainly citations from physico-chemical and physiological journals in which illustrations are given of the influence of the tethered ion on equilibrium in living and non-living systems.

Short Reviews

The Calendar and its Reform. By F. A. Black. Pp. viii+80+3 plates. (London and Edinburgh: Gall and Inglis, 1932.) 2*s.* 6*d.* net.

THIS book describes in detail the various stages which led to the adoption of our present calendar; it begins with the half legendary calendars of Romulus and Numa Pompilius, goes on to the reform of Julius Cæsar, and the alterations (for the worse) introduced by Augustus. There is a chapter on the origin of the names of the months and weekdays, followed by one on the introduction of the use of the Christian era for reckoning years. Then we have the Gregorian reform, and a discussion of the small errors that it involves. Incidentally, it is mentioned that the beginning of the financial year on April 5 is a relic of old style, when the year began on March 25; that day became April 5 after the change. The author is under a misconception in asserting on p. 37 that the slight shortening of the year since the days of Hipparchus depends on the observations made by the latter; it depends on modern observations and calculations.

Mr. Black then comes to the vexed question of calendar reform; he wisely notes that the proposal of many calendar reformers to put five days in four years outside the regular sequence of weekdays excites such strong opposition that there is little chance of carrying it; in fact it blocks the way of reform. The author proposes as an alternative that ordinary years should have exactly 52 weeks and leap years exactly 53 weeks. A simple rule for the fixing of the leap years is given; there are in general two of them in eleven years, but the number is adjusted to give exactly the same number of days in 400 years as in the Gregorian calendar. Under this system the weekdays would recur every year on the same days of the month, which is the principal aim of the reformers; but there would be no tampering with the sequence of weekdays. A full calendar for the next 400 years is given under the proposed system; the greatest divergence from the present calendar is one week.

Suggestions are also given as to the lengths of the months; the author would make them 35, 28, 28 days in each quarter: in leap year one quarter would be 35, 28, 35 days. The lengths of the months are, however, subsidiary to his main proposal.

The Analysis of Fuel, Gas, Water and Lubricants. By Prof. S. W. Parr. (International Chemical Series.) Fourth edition. Pp. xv+371. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 18*s*. net.

THE book is divided into two parts, the former covering a wide range of subjects, with coal as their common basis, the latter dealing with laboratory methods. Such a work as compiled by the late Prof. Parr should have a wide public, if only some means could be devised of gaining its interest. The individual chapters are based on lectures and are most readable, since their writer had the gift of simple and direct expression. An attractive feature for the reader is the emphasis laid on the historical side of the subject, so far as America is concerned: copies of Joliet's map of the Mississippi valley made in 1674 and of La Salle's colony on the Illinois in 1684 show the beginnings of an industry which from a production in 1830 of 320,000 tons, representing a little more than one-fiftieth of a ton per capita, advanced to a total of 550,000,000 tons in 1930, almost 5 tons per head.

The scope of this book is best indicated by the chapter headings; they include the distribution and production of coal, the development of research and the science of calorimetry from the days of Count Rumford onward, in which the work of Parr has played a useful part. Then follow sections on the constitution and classification of coal, the absorption of oxygen, and ignition temperature in relation to the storage of coal. The question of impurities and coal contracts receives attention, also the smoke evil. Combustion and carbonisation are discussed, likewise coke and gas. Sections are devoted to wood, liquid fuels, lubricants and boiler waters.

The book is well illustrated and clearly printed. It is primarily intended for American readers, who are favoured in having available such an adequate summary of the whole subject of fuel.

Bell's Popular Science Series. *Old Trades and New Knowledge: Six Lectures delivered at the Royal Institution.* By Sir William Bragg. Pp. xii+266+42 plates. *The World of Sound: Six Lectures delivered at the Royal Institution.* By Sir William Bragg. Pp. viii+196. *Living Machinery: Six Lectures delivered at the Royal Institution.* By Prof. A. V. Hill. Pp. xiv+256+24 plates. (London: G. Bell and Sons, Ltd., 1933.) 4*s*. 6*d*. net each.

REFERENCE was made in our issue of December 10, 1932 (p. 878) to the first four volumes in this attractive series. Three more have now appeared, all of them emanating from the Royal Institution. Sir William Bragg is a master of the art of popularisation and his lectures on the applications of physics in commercial processes and on sound are models of their kind. Prof. A. V. Hill's Christmas lectures on the machinery of the human body will probably be remembered for the experimental illustrations he gave, using his own children as subjects—to their delight and to the concern of the uninitiated. Messrs. Bell are to be congratulated on the production in cheaper form of these fascinating courses of lectures.

Wave Mechanics: Elementary Theory. By Prof. J. Frenkel. Pp. viii+278. (The International Series of Monographs on Physics.) (Oxford: Clarendon Press; London: Oxford University Press, 1932.) 20*s*. net.

ALTHOUGH complete in itself, this is intended to be the first of three volumes and gives a general survey of the whole subject of wave mechanics. The word 'elementary' in the title should not mislead the reader. The book is not a mere description or attempt to evade mathematics, but is introductory to the more detailed volumes to follow. First comes the derivation of the photon from Einstein's relativity mechanics and its extension to the wave packets of Schrödinger and the uncertainty relation of Heisenberg. The wave mechanics of a particle, system of particles, statistical mechanics and applications of quantum statistics to the electron theory of metals follow.

Photocells and their Application. By Dr. V. K. Zworykin and Dr. E. D. Wilson. Second edition. Pp. xxv+331. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 18*s*. 6*d*. net.

THE second edition is a considerable enlargement of the first. It constitutes a valuable account of photoelectric cells of all kinds, but more particularly of the photo-emissive type. The history of the photoelectric effect is given and is followed by an account of the production of alkali metal films and composite films and of the various processes of manufacture of cells. Circuits suitable for detection are described for all types of cells, photoconductive and photovoltaic as well as emissive, and sufficient theory is given to make the account of value. Applications to photometry, facsimile transmission and television are also included.

Scientific Professionalism

IN contrast to the trade union movement, which has received much attention both in its historical aspects and in relation to the social and economic problems it presents, professional associations have been almost entirely neglected. There has been no study of the historical development of professional association or of the social, economic and ethical problems involved. In view of the growing importance of the expert in public life, the position and influence of professional associations possess a wide interest.

We may perhaps begin with the medical profession. Its present organisation is based upon the Medical Act of 1858, which created the General Council of Medical Education and Registration of the United Kingdom, usually known as the General Medical Council. This Council, which is subject to the Privy Council, has two main duties, to ensure that the unfit do not get on to the register and to expunge the unworthy from it. While the General Medical Council has no option but to register those who produce a licence from a duly accredited authority and tender the prescribed fee, it is empowered to erase a name from the register in certain circumstances; although neither teaching nor examining, it can enforce such minimum standards of education and examination as it pleases. The topics which the General Medical Council is competent to discuss are, however, limited, and exclude, for example, all questions relating to remuneration. These questions, particularly the pay and status of medical officers in the Services and under local authorities, and of practitioners under the National Health Insurance scheme, are main fields of activity of the British Medical Association, though it would be difficult to overestimate the contribution of the latter also to medical science and practice.

The British Medical Association was founded at Worcester in 1832, although it did not assume its present title until 1856. Its membership embraces 35,000 of the 55,000 names on the medical register and probably includes three-quarters of the medical men in practice in Great Britain. Its constitution in its present form dates from 1902 and the effective control of the Association lies with the Representative Body, consisting chiefly of delegates elected by the divisions. The Representative Body is the parliament of the Association and debates at its meetings are keen. Persistent skilful leadership has played a large part in raising the status and remuneration of doctors and although there is little evidence regarding the average income of the general practitioner, it is significant that the Association is able to obtain a minimum commencing salary of £600 a year for a whole-time medical officer of the lowest grade. At the arbitration inquiry in 1926 it was stated that £1,200 might be the average income from a successful practice "not at the top". Evidence was given before the Royal Commission on the Civil Service in 1930 that a fully employed panel doctor in a populous area, using half his time for panel and half for private practice, could make £1,400 net per annum. The salaries offered to medical men are considerably higher than those for dentists or for veterinary surgeons.

The position of the veterinary surgeons presents analogies with the position of the medical profession but is weaker mainly through the neglect of veterinary science in Great Britain. The Veterinary Surgeons Act of 1881 laid upon the Royal College of Veterinary Surgeons the duty of keeping a register but, unlike the General Medical Council, also of examining the students of recognised veterinary colleges. It possesses disciplinary powers and its members have certain privileges similar to those granted to doctors. The numerical weakness of the profession—the register contains 3,473 names for the British Isles—and prevailing indifference to veterinary science largely account for the comparative impotence of the National Veterinary Medical Association.

The engineering profession offers strong contrasts to the conditions of the medical profession, particularly in the absence of any legal register and in the number of specialist organisations which have developed as the range of engineering grows. The parent society is the Institution of Civil Engineers, founded in 1818, the activities of which for the first fifty years were confined to study. For long enough membership, however, did not imply scientific training and only in 1897 did the Institution establish its own examinations. There are grades of membership, corresponding to different degrees of attainment and experience. Associates must be more than twenty-five years of age and have passed either the examinations of the Institution or an approved examination and have undergone a specified period of practical training. Members must be more than thirty-three years of age and have been associates with five years' experience in a position of responsibility, or have had "suitable education and training as a civil engineer" and fifteen years employment in a position of responsibility and have acquired "a considerable degree of eminence in the profession". Rules governing the professional conduct of members were not formed until 1910 and their general purport is to ensure that the engineer's utmost skill shall be placed at the disposal of those who employ him, and that the method of remuneration shall not involve any conflict between his personal interests and those of the clients whom he advises.

Round the Institution of Civil Engineers have sprung up the Institution of Mechanical Engineers, the Institution of Naval Architects, and the Institution of Electrical Engineers, as well as other junior institutions such as the Institution of Mining Engineers, the Institution of Structural Engineers, the Institution of Automobile Engineers, the Institution of Gas Engineers and the Institution of Chemical Engineers. These are not rival associations though they are modelled on the parent society and the membership overlaps considerably. The civil and mechanical engineers have memberships of about 10,000, the 'electricals' about 11,500, the naval architects about 3,000 and the mining engineers 3,800. The number of qualified engineers in Great Britain is estimated at 26,659.

The professional organisation of chemists in Great Britain has been handicapped by the assumption of the title of "chemist" under the Pharmacy Act of 1868 by members of another vocation possessing one or more alternative titles. The growth of the profession is frequently referred to the formation of the Chemical Society in 1841, which, however, has remained a study society and never demanded scientific or practical qualifications of its members. The first steps at professional organisation were taken in consequence of the passing of the Sale of Food and Drugs Act in 1875, and led directly to the founding of the Institute of Chemistry in 1877. Although its interests were originally mainly limited to those of analytical and consulting chemists, since 1918 it has included a large number of those practising in industry. Its present membership of nearly 6,000 probably represents from one half to three quarters of the fully trained chemists in Great Britain.

The Institute of Chemistry has done much to raise the status of the public analyst, but it has been able to do relatively little to raise the status or remuneration of the chemist in general, and the prestige and value of its membership have not become such that all qualified to obtain it do in fact apply. More effective professional defensive work for chemists generally is being done by the British Association of Chemists, in spite of a much smaller membership—a little over 1,000—largely on account of the greater freedom permitted by its constitution and by its registration under the trade union acts. The Institute of Chemistry is an examining body but the fellowship and associateship can be obtained with partial or complete exemption from examination by those holding recognised degrees or diplomas with first or second class honours in chemistry. The British Association of Chemists also admits those with a sufficient general education and scientific training who have had at least seven years' practice in pure or applied chemistry. The estimated number of chemists is about 10,000 of whom not more than 350 are in private practice. Inquiries conducted by the Institute of Chemistry in 1930 indicated that 15 per cent of fellows at home were receiving between £1,000 and £1,500 and nearly 50 per cent between £500 and £1,000; of associates at home 25 per cent were receiving £500 to £1,000 and 62 per cent from £250 to £500. Members abroad were getting considerably higher salaries.

Reference has been made to the pharmacists, whose early history is closely related to that of the medical professions through the apothecaries and "chemists" and "druggists". The Pharmacy Act of 1868 prohibits any person from selling or keeping open shop for retailing, dispensing or compounding specified poisons or from using the title "chemist and druggist", or "chemist", or "druggist", or "pharmacist", or "dispensing chemist", or "druggist", unless registered by the Pharmaceutical Society. Up to 1919 the latter society not only fulfilled its statutory obligations of examining and registering but it also looked after both the professional and trading interests of pharmacists. In consequence of the judgment in a test case in 1920 the Retail Pharmacists' Union was established, to which were transferred all employers' functions and those of negotiating with the Government regarding the National Health Insurance Act.

Up to the formation of the Institute of Physics in 1920 the physicist had scarcely been recognised as one of the professions, being mainly confined to the universities. The increasing demand for physicists in industry led to the formation of the Institute, which differs considerably in constitution from the Institute of Chemistry. Members of any of five participating societies, which are study associations, can become ordinary members, but the corporate members in whom authority is vested consist of fellows and associates who must have passed either the examination of the Institute or an equivalent examination. Fellows in addition must have had five years' experience. There are 600–700 corporate members and the Institute of Physics has a much more effective command of the profession than has the Institute of Chemistry.

The emergence of the true patent agent possessing a skill partly legal and partly scientific is of comparatively recent date, and the number of qualified patent agents in Great Britain and Ireland is only 343. Since, however, salaried employees in a patent agency are not required to register, there are many qualified persons who have fulfilled all the requirements but have not proceeded to registration. A register of patent agents was established by the Act of 1888, but effective protection was only conferred by the subsequent Patent and Designs Act of 1919, which lays it down categorically that "no person shall practice . . . as a patent agent, unless . . . he is registered". The register is kept by the Institute of Patent Agents and admission is confined to those who have passed a preliminary, an intermediate and a final examination conducted by the Institute. Candidates for the final examination must have served for five years in the office of a registered patent agent, although articles are not obligatory and some exception is granted to those who have graduated at a university or spent a specified time at an approved technical college, or an approved profession or industry or on the examining staff of the Patent Office. In spite of its important educational duties, the Chartered Institute of Patent Agents is a voluntary association and only about two-thirds of the registered patent agents are members.

The recently published work by Prof. A. M. Carr-Saunders and Mr. P. A. Wilson* on the growth and position of the professions, on which the above remarks have been based, is a welcome and valuable attempt to fill a serious gap. The first part gives a survey of the present position of the recognised professions and of other occupations with more or less definite claims to be recognised as professions, and forms an invaluable reference work with regard to qualifications, numbers of practitioners, salaries or positions obtainable in a wide range of professions.

Special interest is attached to the sections dealing with architects and with teachers, one on account of the recent efforts to obtain a registration which issued in the Architects (Registration) Act of 1931, the other on account of the growth of unity in a profession formerly separated by deep-seated jealousies and also on account of the influence of widespread State employment leading to what is in effect a State register of teachers. So, too, the analysis of the conditions which led to public accordance of professional status to the civil service and to local government service, and of those again which prevail in the mercantile marine or among mine managers, are invaluable to all scientific workers who seek to understand the place and functions of professionalism in modern society and to assess the contribution which registration can offer alike to the advance of the professions or of the State they serve.

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* "The Professions". By A. M. Carr-Saunders and P. A. Wilson. Pp. viii+536. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 25s. net.

Taxonomy and Evolution

By DR. W. H. LONGLEY, Marine Biological Laboratory, Tortugas, Florida.

TEN years ago Dr. J. C. Willis developed in his work "Age and Area" his discovery of the existence of an unexpected order in Nature revealed by statistical analysis of selected data of taxonomy. Prof. Bateson expressed keen appreciation of this discovery in a review of the work in NATURE[1]. The sign of order represented was, in Bateson's judgment, highly significant and is the central fact to which the present contribution is related.

In the great natural groups of organisms—the larger families and orders—the statistical distribution of genera by size is approximately the same in all cases; or, to put it in other words, the curve of genera plotted against the number of their species is always of the same general form. This suggests at once that the process of evolution occurs according to law. Indeed, only if the naturalist's conception of genera and species is without justification in the order of Nature itself, or if his classification of material given by Nature is grossly inadequate, may the direct inference be avoided. But, letting the necessary inquiry this suggests rest for the moment, is there independent reason for supposing the process of differentiation of genera and species of organisms may occur according to law?

Manifestly such law as is suggested by Dr. Willis's discovery is one of a statistical sort, a description of the outcome of the evolutionary process as a whole and without regard to detail—a law, indeed, of the general order of the gas laws of physics, where the individual is quite lost to sight. If it be urged that such laws do not deal with underlying truths, it may be admitted at once that they are not exhaustive accounts of the events in systems of which they treat: but they are still laws, and laws, too, of a high order of importance.

The laws of gases (with similar statistical laws) have, in fact, served as the foundation, from one point of view, of our modern industrial civilisation, with all that it entails. If to know how things go, on the whole, with molecules in the gaseous systems they compose, has shown itself so significant a matter, we may believe that the like knowledge of what is involved in the making of genera and species will justify itself. It requires no lively imagination to foresee some of its effects upon our thought, where its important application will chiefly lie.

To consider the gas laws further: these are generalisations empirically established and the basis upon which the kinetic theory of gases rests. It is from them that we derive our idea that the normal gas is a system of ultra-microscopic particles, active and acting at random, incapable of reproduction and variation, capable of exerting an influence upon one another measurable at last as pressure against the weight of a column of supported fluid.

Now clearly there is no theoretical reason why there might not be systems of units differing from molecules in few or many respects, but still active and acting on one another at random, and on that account having among their laws some of the form of the gas laws. Such systems might be composed of macroscopic, as well as of ultra-microscopic units, units capable of exercising some other influence upon one another than that measurable after the precise fashion of gas pressures, units capable of varying or of increasing their number by some sort of reproductive process, or of at once reproducing and varying.

To express such ideas is only to suggest that the kinetic theory of gases is capable of generalisation, and of being applied, *mutatis mutandis*, to a variety of systems, real or imaginary: call them 'kinetic systems', systems the units of which, whatever they may be, are active and act upon others of their kind at random.

Such systems as are proposed do, in fact, exist. 'Glowing gases' are an example. These obey the gas laws but their units are variable. Defective as it may be in detail, Bohr's schematic representation of the structure of the atom and of what is involved in the absorption and release of more or fewer quanta of energy has made this a matter of common knowledge. More still, if the atom's power to vary is exercised, so to speak, under the control of pressure in the glowing gas, the law of distribution of energy in the line spectrum will —when it is made out—prove to be one from which, if it had been first formulated of gas laws, Boyle's, Avogadro's and others might have been derived by inspection. It will be the master-law of the system.

Populations of a single sort of organism, growing under such conditions as are maintained for determining their law of increase, are also kinetic systems in the sense defined. Their law of growth is a master law from which laws of the form of the gas laws may be derived by inspection[2]. They are clearly systems of units, active and acting at random upon one another, but macroscopic ; for practical purposes incapable of effective variation within the life of the experiments ; capable of reproduction, and exerting an influence upon one another measurable as an effect upon their proportional rate of increase as they grow.

To avoid the inference, it is necessary to disprove the premises from which it is deduced by logical process. In an attempt to invalidate the law of growth of populations, it is as little to the point to refer to unanalysed experience in the field as it would be to cite the wavering course of a mote in the sunbeam in contravention of the laws derived for bodies falling *in vacuo* under the influence of gravity. In each case advanced as exceptional, the fundamental law is undoubtedly momentarily obeyed.

Evolution is the process of differentiation of a compound population, a population composed of more than one sort of thing, one in which the unit is not the individual but a natural group of individuals related by descent. So Dr. Willis's discovery suggests only that besides the three sorts of kinetic system definitely recognised—and with recognised laws—there is a fourth, the compound population, of which the characteristic process of differentiation also occurs according to law, the master law of this kind of system.

To reach a final decision regarding the soundness of these suggestions, one may first validate the taxonomist's conception of genera and species as groups objectively existing[3]. The empirical curves of genera plotted by size may then be determined as accurately as possible. In course of this work, it appears that in no great group of organisms are known species a representative sample of the world population[4]. The curves therefore change as knowledge grows respecting the groups to which they individually refer. But as they change, they tend to assume the same limiting form, which is a function of the curve of normal frequency.

Space does not permit the argument to be carried here to its logical conclusion. This requires that it be shown that the curve derived from analysis of the data of taxonomy is what theoretical considerations indicate it should be. But even if it be left for the moment an open question whether the law of evolution is the law of differentiation of a particular sort of kinetic system, the existence of the law as such justifies the confidence expressed in the validity of the species conception one finds so commonly in some sense in the writings of systematists, and nowhere more plainly than in contributions by the scientific staff of the British Museum (Natural History).

The light it throws upon existing order in Nature—specifically in the matter of evolution—establishes taxonomy as a science, its place among the biological sciences being comparable to that of astronomy among the physical sciences. It deals with the products of a process as nearly cosmic, as nearly transcending the resources of the experimental method, as anything biology knows.

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[1] NATURE, **111**, 39, Jan. 13, 1923.
[2] *Science*, **75**, 248–250, Feb. 26, 1932.
[3] *Proc. Linn. Soc. Lond.*, April 6, 1933.
[4] *Science*, **78**, 700–702 ; **72**, 141. Proc. Sixth Int. Congress Genetics, **2**, 120–128 ; 1932.

Iraq Petroleum and Pipe-Line

AS M. Victor Forbin so graphically explains in a recent article on "Le Pétrole de Mésopotamie et son Pipe-Line" (*La Nature*, No. 290, pp. 253–262, March 15, 1933), the petroleum industry of Iraq is historically the oldest and commercially the youngest in the world. In spite, however, of sundry biblical and legendary references to natural resources, negotiations for the acquisition of oil land were not opened until the beginning of this century, and no definite concessions were granted until 1928, when the Iraq Petroleum Co. was founded. Even at this stage, further development of the petroleum industry in Iraq was not assured, for it had yet to be discovered whether the seepages were in fact indicative of untapped resources or merely the dregs of ancient pools.

In 1925, twelve enterprising geologists of various nationalities set out on an expedition to Iraq. Undaunted by extremes of temperature, hostile attacks from nomadic tribes and the numerous problems of structure peculiar to that country, they selected ten sites for testing purposes. The first well drilled in one of these sites, Baba Gurgur, near Kirkuk, was the scene of a great disaster. The boring unexpectedly pierced a dome, of which there had been no surface indication, and liberated a gusher of oil which had finally to be diverted into channels and set on fire in order to prevent further catastrophe. Additional precautions were necessarily taken in drilling subsequent wells on this site, with the result that a prolific production was obtained. In fact, so prolific is the production that to fulfil an annual contract of 4 million tons, only fifteen of the thirty wells drilled need be tapped. Moreover, as Kirkuk is the only one of the ten selected sites which has been developed, the future supply of Iraq oil is potentially enormous.

The pipe-lines which run from the oilfield to the Mediterranean sea are among the most remarkable of their kind. There are longer lines in the United States, but none required greater engineering skill and endurance. Practically the whole line is laid through barren inaccessible territory and the workers are obliged to make roads, huts and means of communication before they can begin on actual construction. Moreover, they have frequently suffered from shortage of drinking water and have had little or no protection against extremes of heat and cold.

The proposed pipe-line course was modified several times in the early stages of the project, but the final form is that of the letter Y. The pipes run in a double track from Kirkuk, across the Tigris to the Euphrates where they fork, one line northward and the other southward. The former is the shorter and easier route and terminates at El Mina, near Tripolis. The southern line, which has proved much more difficult to lay, is not yet completed, but will eventually be carried to the Bay of Acre near Haifa. Two thousand kilometres of steel tubes, representing a weight of 116,000 tons, have been laid at depths varying from one to several metres, through the most difficult territory in the world, in order to accomplish this engineering feat. Moreover, 500 Europeans and Americans and 6,000 natives have been employed in the construction. The cost of laying the lines is naturally considerable, having regard to the peculiar difficulties which had to be overcome, and the question arises as to whether the construction is, and will be, in the future, economically worth while.

In the first instance, Tripolis and Haifa are geographically better situated for the exportation of petroleum than the ports of Russia and Roumania, or even of the New World, for they are considerably nearer the chief centres of importation. Cost of transport will therefore be low in comparison with that paid by rival countries. Cost of production is likewise low owing to the large quantity of oil procurable from each well, the vast dimensions of the oilfields, and the ease with which drilling operations are effected. It is therefore conceivable that the oil of Iraq will in the future be the cheapest and most accessible in the world, although it originates in, and has to flow through, such apparently impossible territory.

Obituary

HARRIET BROOKS (MRS. FRANK PITCHER)

HARRIET BROOKS (MRS. FRANK PITCHER), who died in Montreal on April 17, was well-known in the years 1901–5 for her original contributions to the then youthful science of radioactivity. A distinguished graduate of McGill University, she was one of the first research workers with Prof. (now Lord) Rutherford in Montreal. She observed that the decay of the active deposit of radium and actinium depended in a marked way on the time of exposure to the respective emanations and determined the curve of decay for very short exposures. This work, which was done before the transformation theory of radioactive substances was put forward, assisted in unravelling the complex transformations which occur in these deposits. With Rutherford she determined the rate of diffusion of the radium emanation into air and other gases. These experiments were at the time of much significance, for they showed that the radium emanation diffused like a gas of heavy molecular weight—estimated to be at least 100.

Miss Brooks entered the Cavendish Laboratory, Cambridge, in 1903 and continued her radioactive investigations. In a letter to NATURE of July 21, 1904 (vol. 70, p. 270) she directed attention to a peculiar type of volatility shown by the active deposit of radium immediately after its removal from the emanation. In the light of later results of Hahn and Russ and Makower in 1909, it is clear that the effect was due to the recoil of radium B from the active surface accompanying the expulsion of an α-particle from radium A. This method of separation of elements by recoil ultimately proved of much importance in disentangling the complicated series of changes occurring in the radioactive bodies.

After her marriage to Mr. Frank Pitcher of Montreal, she gave up her research work but took a strong interest in university affairs. In this she was aided by her family ties, for one sister is the wife of Sir Charles Gordon, a prominent supporter of McGill University, and another the wife of Prof. A. S. Eve, professor of physics in McGill University. A woman of much charm and ability, she was a welcome addition to any research laboratory and left in all who met her a vivid impression of a fine personality and character. R.

DR. H. BASEDOW

THE recent death of Dr. Herbert Basedow at the age of fifty-two years, which is announced in a dispatch by Reuter from Adelaide, will be deeply regretted by anthropologists in Great Britain, where his persistent and courageous efforts on behalf of the Australian aborigines, which brought about the allotment of an extensive reservation for those of the central area, were widely appreciated and received influential support. Since the death of Sir Baldwin Spencer, Dr. Basedow had been generally recognised as the first authority on the aborigines of Australia.

Dr. Basedow was born in Adelaide on October 27, 1881, the son of a former minister of education, and was educated at Prince Alfred College and the University of Adelaide, studying later at the Universities of Göttingen, Heidelberg, Breslau and Zurich. He entered the South Australian Geological Service; but in the course of a number of expeditions to the interior of Australia, he became interested in the Australian aborigines, both scientifically and from the practical point of view of their protection from the deleterious influences of contact with civilisation. On several occasions he lived among them for considerable periods for purposes of study. In 1911 Dr. Basedow was appointed Chief Protector of the Aborigines for the Federal Government in the Northern Territory and he was also Medical Commissioner of Aborigines under the South Australian Government.

Basedow had achieved a considerable reputation by his contributions to scientific periodicals, including the publications of the Royal Anthropological Institute of Great Britain. This he consolidated by his chief work "The Australian Aboriginal" published in 1925, a record of careful observation, which also showed considerable originality in interpretation. He showed himself a vigorous controversialist in the local press on behalf of the aboriginal. In 1928 he undertook his most important piece of zoological and anthropological research when he led an expedition to Arnhem land. On his retirement from his official position, he entered business and politics and was elected a member of the Adelaide legislature in 1927.

WE regret to announce the following deaths:

Major W. C. Ball, O.B.E., superintendent of the Chemical Department, Porton, on June 9.

Mr. William B. Bannerman, known for his work on local archæology especially of Kent, Surrey and Sussex, on June 6.

Prof. W. L. Elkin, emeritus professor of astronomy in Yale University and director of the Yale Observatory from 1896 until 1910, on May 29, aged seventy-eight years.

Sir Walter Morley Fletcher, K.B.E., C.B., F.R.S., secretary of the Medical Research Council, on June 7, aged fifty-nine years.

Dr. J. G. Hibben, formerly president of Princeton University, who has published several textbooks on logic and psychology, on May 16, aged seventy-two years.

News and Views

The World Economic Conference

HIS MAJESTY THE KING in opening the World Economic Congress on June 12 proclaimed his satisfaction that such a gathering had been possible and expressed his confidence that this common endeavour would lead to beneficial results. Unlike that of 1927, the Conference is a Conference not of officials but of Governments, in fact of all the Governments of the world, since it includes the representatives of some sixty-six nations. The magnitude of the task confronting the Conference and the difficulties involved are great but, as His Majesty stated, there is evidence of a real desire to reach agreement. All nations are suffering from a common ill as is shown only too clearly by the rise in the figure of unemployment. In appealing to all the representatives to co-operate for the sake of the ultimate good of the whole world, in the face of a crisis which all realise and acknowledge, the King stated that it cannot be beyond the power of man so to use the vast resources of the world as to ensure the material progress of civilisation. No diminution in these resources has taken place. On the contrary, discovery, invention and organisation have multiplied their possibilities to such an extent that abundance of production has itself created new problems. There has come also a new recognition of the interdependence of nations and of the value of collaboration between them. Therefore, as His Majesty stated, there is now an opportunity of harnessing this new consciousness of common interests to the service of mankind. His Majesty's speech and also that of Mr. Ramsay MacDonald, who followed the King, were broadcast by the British Broadcasting Corporation, and a record of the King's speech was made by His Master's Voice Company.

Sir Prafulla Chandra Rây, C.I.E.

SIR P. C. RÂY stands alone amongst Indian men of science not only on account of his scientific attainments but also for his public activities. In December last his colleagues and former students took advantage of his seventieth birthday to show their appreciation and esteem by presenting him with a congratulatory address in which they announced that a considerable sum had been subscribed which would be applied to assist indigent students. The Indian Chemical Society has dedicated a handsome commemoration volume to its first president and it has thus enabled Sir Prafulla's friends in other countries to show their appreciation of his services to science ("Sir Prafulla Chandra Rây". Seventieth Birthday Commemoration Volume. *Journal of the Indian Chemical Society*, Special number. Pp. vi+363. Calcutta: Indian Chemical Society, 1933.) This volume of more than 300 pages contains 36 papers and, although the majority of these are naturally by Indians, chemists from Great Britain, America, Germany, Austria and Switzerland have also contributed. Pride of place is fittingly given to a paper by the president of the Chemical Society, Prof. G. T. Morgan, who, with Dr. F. H. Burstall, gives an interesting account of recent high-pressure work which has been carried out at the Chemical Laboratory, Teddington, on the dehydrogenation of pyridine with anhydrous metallic chlorides. One of the products of the reaction, 2 : 2′-dipyridyl, yields particularly important co-ordination compounds (Nature, 128, 31, July 4, 1931).

The two other contributions from Great Britain are by Prof. M. W. Travers and Prof. F. G. Donnan, the former discussing the pyrolytic condensation and decomposition of ethane in the presence of hydrogen, whilst the latter presents a short but stimulating note on the thermodynamic functions of radiation. Students of the chemistry of the polysaccharides will welcome a valuable résumé of recent investigations in this field from the pen of Prof. H. Pringsheim. Another paper of great interest by Prof. Franz Fischer summarises the valuable work on the utilisation of coal gas which he has carried out during the past few years. As would be anticipated by those who have followed the trend of chemical research in India, the majority of the papers by Sir Prafulla's former students are on physico-chemical themes and are of interest mainly to the specialist. Prof. M. N. Saha has, however, written a remarkably able review entitled "Spectroscopy in the Service of the Chemist". The contributions to this commemoration volume reach a high standard and augur well for the future of the schools of chemistry in India of which Sir Prafulla may with justice regard himself as the founder.

Mr. Pierre Chevenard

The "Société d'Encouragement pour l'Industrie Nationale" awards annually a special medal with the effigy of an eminent person in science or arts to a French or foreign author whose work has had the most effect on the progress of French industry. The medal for 1932 bears the effigy of Prony and has been awarded by the Committee of the Society dealing with mechanical arts to M. Pierre Chevenard, a mining engineer of the Mining School at Saint Étienne. Born in 1888, M. Chevenard has, since 1910, worked in the research laboratory at Imphy of the metallurgical works of Commentry, Fourchambault et Décazeville. One of his most important papers deals with an experimental research on iron, nickel and chromium alloys, but he is especially known for elaborating devices for the examination of very small quantities of alloys. With small samples a homogeneous temperature is secured throughout the piece, this being important for quick and reliable measurements, and M. Chevenard was able to examine the physical properties of alloys over a wide range of temperature. His differential dilatometer, galvanopyrometer, and apparatus for the examination of the mechanical properties of alloys, are widely used all over the world. Besides purely scientific research, M. Chevenard has contributed a great deal to the production of special alloys at Imphy, such as M. Ch. Guillaume's invar, elinvar and the A.T.V. ferro-nickel alloy.

Concealing Coloration of the Tapir

The birth at the Gardens of the Zoological Society of London, last week, of a Brazilian tapir is worth recording, since it will afford visitors to the Gardens an opportunity of examining one of the most striking types of 'protective', or 'concealing coloration' in young mammals to be found anywhere. It takes the form of numerous longitudinal white stripes on a black background. The stripes tend to break up into short bars and spots on the flanks, while the legs are obliquely striped. The face is spotted. This coloration is the more interesting because the young of the Malayan tapir is coloured after a closely similar fashion; while the adults of the two species are as unlike as could well be. In the young Malayan species the spots on the face are more numerous and distinct, while the stripes down the sides are rather more sharply defined and less broken up on the lower flanks. As the animal approaches maturity these markings fade out in a very curious way. As the great white area of the body behind the withers gradually shows up, the stripes fade out; but they persist far longer on the black fore-quarters and the face. The strange coloration of the adult Malayan tapir affords another striking example of 'concealing coloration', since when asleep in dry boulder-strewn water courses these animals look themselves like boulders, the white area forming the summit while the black fore-quarters and legs simulate the deep shadows cast by such boulders in the intense sunlight.

Theory in Modern Physics

The leading idea of Prof. A. Einstein's Herbert Spencer lecture, entitled, "The Method of Theoretical Physics", delivered at Oxford on June 10 was the relation between experience and reason in the domain of physics. The Greeks, he said, perfected a logical system in which, considered as such, no flaw could be found. But it was a closed system; and its concepts and laws, though for long believed to be derivable from the data of experience, were entirely a creation in the mind of the theorist. The practical success of theory in the hands of Newton obscured during the eighteenth and nineteenth centuries the want of correspondence, now evident, of pure theory with the results of experience. But though the view that prevailed for so long must be discarded, Prof. Einstein believes it to be possible for the theorist to construct a system that will be a true model of reality. Experience cannot give the answer to the problem of Nature, but it can suggest the methods which will enable the theorist to arrive at a solution.

Inadequacy of Economic Sanctions

In a recent issue of the *New Commonwealth*—a journal devoted to the promotion of international law and order—Dr. J. J. van der Leeuw discusses the inadequacy of economic sanctions. The greater the measure of disarmament, he writes, the greater the need for sanctions. Complete disarmament, though this is the only safe basis for a lasting peace, is unthinkable without safeguards against aggression by an improvised attacking force. Such safeguards, however, must not merely consist of coercive measures against an aggressor nation; they must be a protection against aggression. It is in this respect that economic sanctions fail whether they take the form of an economic and financial boycott of the aggressor or that of a regular blockade. (1) They come too late; they can only be applied as a corrective; they do not protect against aggression. (2) Economic sanctions are notoriously slow in their application. (3) They are a double-edged weapon, striking at international trade and punishing the innocent with the guilty. (4) Economic sanctions are powerless against nations which can, if need be, form self-sufficient economic units, such as the United States to-day and the U.S.S.R. to-morrow. Dr. van der Leeuw contends that an international police force alone would make complete disarmament possible, since it would provide security against aggression, not merely coercion afterwards. Each nation would contribute its quota to the world police and, having done so, would not be further involved.

Old Gaza

SIR FLINDERS PETRIE's letter to the *Times* of June 2, announcing that it would not be possible this year to hold the usual exhibition of material from the Palestinian excavations of the British School of Archæology in Egypt, will give rise to much regret. The members of the school, Sir Flinders reports, this year have been engaged for the third season in succession in the excavation of Old Gaza (Tell el Ajjul), where the earliest palace, dated at about 3200 B.C., discovered last year, awaited clearance. It now appears that the foundations were laid in a rectangular block about 127 ft. from north to south and about 166 ft. in length. The buildings enclosed a large square courtyard with chambers on three sides, but with an enclosing wall only on the fourth, or south, side. Egyptian influence is strongly marked in a number of small objects and a finely carved stone head from a funerary jar, which is earlier than any from Egypt. Greater interest, perhaps, is attached to several objects which may point to the place of origin of the Syrian invaders. These were a bronze dagger with raised veins, very similar to one found last year, which is a Caucasus type, and two forms of toggle which belong to the same area. The burial was early, while from a superimposed burial came a scarab which cannot be later than the xith dynasty. South of the palace area massive buildings were uncovered in a sand dune which yielded fragments of painted pottery, similar to that found last year, of which the origin is still obscure, although northern Syria, Armenia or Cappadocia are indicated. The buildings with which this pottery was associated were of the age of the first and second palaces—viith and xiith dynasties. Other parts of the Tell have been excavated, yielding nearly two hundred types of pottery, and the family tomb of an Egyptian governor, which indicates a continued Egyptian occupation from the time of Akhen-aten to Rameses II. A second gold torque ear-ring of Irish pattern occurred in an xviiith dynasty level.

Local Archæological Observation in the United States

USEFUL information relating to local archæological sites and discoveries, which might otherwise be disregarded as unimportant and lost to sight, is being recorded through a system of local correspondents and investigators inaugurated by Science Service (Washington, D.C.). Naturally the information varies considerably in value and interest; but as time goes on, the organisation should serve a useful purpose in preserving data which will assist in determining the character, distribution and relation of the Indian cultures which had become extinct before the days for which records of the tribes are available. An instance in point is afforded by a communication recently received by Science Service from Mr. William E. Baker of Boise City, Oklahoma, who describes Indian ruins on the south bank of the Beaver River, four miles south of Optima, Oklahoma. The ruins are of the type known as 'slab house', being constructed of stone slabs, set on edge. Before the depredations of neighbouring builders, they covered a site of several acres. Their artefacts, flint arrow points, drills, snub-nosed scrapers, and bone implements, are such as have a wide distribution in the Plains, being found in the western half of Kansas, the panhandle of Oklahoma and of Texas. They have also been found at Pecos Pueblo. Mr. Baker differentiates two cultures, partly on stratigraphical grounds. The earlier is characterised by a small arrow point with right-angled notches, which is associated with pottery of the Plains type. In the later the arrow point is large and has diagonal notches, but pottery is absent. The former was probably partly agricultural—a view supported by a suggestion of irrigation and the discovery of kernels of corn—the latter nomadic. This order and association has been found by Mr. Baker over a wide local area while the cultures are related to types described by Dr. W. K. Moorehead on the Arkansas River and Dr. A. W. Kidder at Pecos Pueblo. Mr. Baker suggests that there was a widely distributed semi-agricultural population spread over the Plains before the coming of the Spaniards, when the introduction of the horse made possible a nomadic life dependent on the buffalo.

Oil Reserves and Production

SOME interesting figures of oil reserves and past production to date were given by Mr. V. R. Garfias to the American Institute of Mining and Metallurgical Engineers recently. According to this authority, the proved oil reserves are estimated at more than 24 billion barrels and the world production of oil to date aggregates nearly 23 billions. Of the realised reserves, 61 per cent are located in the American continent, while Russia, Iraq and Persia account for 33 per cent. Science Service of Washington, D.C., states that the American reserves, when compared to the probable future consumption in the United States, will prove inadequate to meet demands for more than a few years, unless there should be a pronounced falling off in demand. It is considered that the Venezuelan, Iraq and Rumanian fields will in the future become, in varying degrees, potential sources of instability in the world's oil trade, but in this connexion it would seem that the growing importance of an ever-increasing Russian production has not been assessed at its true significance. Further, Mr. Garfias's figures do not consider estimates of potential oil reserves but cover only the world's oil supplies estimated to remain underground in the present-known producing fields and their anticipated extensions.

Electric Trolley Omnibuses

ABOUT twenty years ago, electric tramways had no serious rivals for street passenger traffic. As they are doing to-day, they were then carrying a very large number of passengers. The advent of petrol and electric omnibuses was not considered as a serious menace to their prosperity. They would doubtless be useful in those districts where the cost of installing tramway track was prohibitive. In a paper read to a joint meeting of the Institution of Electrical Engineers and the Institute of Transport on April 10, C. J. Spencer described the progress made in developing electric trolley omnibuses during the last twenty years and discusses the general problem of street passenger traffic. The great advantage of a trolley omnibus is that it can use a series electric motor—the most perfect of all traction motors. It gives its maximum torque when starting and can carry an overload of a hundred per cent for several minutes without damage.

THE War hindered the development of the trolley bus. Ten years ago, only 47 route miles were operated in Great Britain. Last year the number had increased to 256 miles and numerous extensions are being planned. The modern electric bus is little more than an adapted petrol bus; the engine and gear box have been removed, an electric motor substituted and a trolley collecting gear bolted on the roof. The weight of the motor used for trolley bus operation is only 12 lb. per horse power. This compares with 70 lb. per horse power in pre-War days. In the early buses, two motors of 20 h.p. were used in each bus but now a single 80 h.p. motor is used. This is capable of withstanding the roughest usage. The London United Tramways Co. recently converted 17 miles of route between Twickenham and Wimbledon into trolley bus operation. At the start, many complaints were made by possessors of radio sets of extraneous noises in their apparatus due to 'interference' by the buses. Thanks to the help of the General Post Office and the British Broadcasting Corporation this trouble has been practically overcome. On busy routes, evolution of design has led to a continual increase in the size of the vehicles.

National Research Council of Canada

THE fifteenth annual report of the National Research Council of Canada (Ottawa) surveys the activities of the Council in the period 1931–32. The demand for scientific assistance from industrial groups was greatly increased and, during the year, the Council considerably extended its direct relations with industry, a number of associate committees having been formed as a result of the Council's effort to relate itself with industrial development. The Council is largely echoing the views of the Advisory Council for Scientific and Industrial Research in Great Britain in asserting, and demonstrating from its own experience, that science will not occupy its proper place until the industrialist is ready, not merely to admit the possibilities of research and accept its assistance, but also to co-operate fully and on a confidential basis with workers in the scientific field. The report summarises the activities of the laboratory divisions as well as the activities of associated committees and the reports of assisted researches. From this wealth of information it is impossible to select more than a few points illustrating the scope of the investigations covered. Both in the Division of Chemistry and in that of Biology and Agriculture, considerable attention has been devoted to chemicals and herbicides as well as to the fire hazards attached to their use. Synthetic rubber and resins and the efficiency of detergents are other questions investigated by the Division of Chemistry, while the Division of Physics and Engineering has been concerned with aeronautics, locomotive research, and fire hazards of oil burners. Associate committees have dealt with a wide range of problems of animal diseases, field crop diseases, coal classification and analysis, engineering standards, gas research, grain research, leather, magnesian products, oceanography, radio research, tuberculosis, weed control, and wool.

Agricultural Societies

THE gain to agriculture from the activities of the various agricultural societies which have flourished during the last two centuries must be enormous. These associations, supported by landlord enthusiasts bent on improving their estates and raising the standard of farming, have spread agricultural knowledge by their publications, by the offer of prizes for information or practical achievement, and by their shows of implements and live-stock. They have continually fostered scientific inquiry into the technical problems of farming, and in their journals are to be found the successive landmarks of agricultural progress. On June 8, 1723, was founded the earliest association of this kind in Scotland under the title "The Honourable the Society of Improvers in the Knowledge of Agriculture in Scotland". Its members were certain noblemen and gentlemen who were impressed by the backward state of farming at this period. The Society was concerned with the collection and dissemination of the best agricultural information. It advised members on their farming problems; on cultivations, including the new horsehoeing husbandry of Jethro Tull, on sheep folding and on cattle feeding. Under the last heading the recommendation that the cattle be "not less than seven years old" before feeding commences, reads rather strangely in these days of 'baby beef' and rapid turnover. On the other hand, few stockmen will find fault with this:—"Be sure to prepare a careful hand to attend the feeding of them, for upon this depends the whole success of the attempt". The Society concerned itself with fisheries and manufactures in addition to its main objective. It did not survive the upheaval of 1745, but for twenty years supplied a need which more permanent societies were later to satisfy.

Research in Germany

THE issue of *Die Naturwissenschaften* for May 26 is devoted to the work of the Kaiser Wilhelm Gesellschaft zur Förderung der Wissenschaften and extends to more than eighty pages. The year ending March 1933 has been a difficult one for the society, and the hope is expressed that the Government will in the future be able to afford it more financial support. Its membership is now 786, a fall of more than 40 on the year. Its headquarters—Harnack House—provides accommodation for the meetings of more than thirty societies in addition to those of its own sections, daily meals for 160 scientific workers, and has put up for short stays 230 visitors during the year. Evening lectures, by distinguished members of the staff, have been given both at headquarters and in other towns of Germany as in previous years. In addition to outline reports of the work of each Institute, lists of papers published by the staffs are given, and both show how much the society is doing by scientific research to increase the welfare of Germany and to maintain its position amongst those bent on "improving natural knowledge".

Annual Meeting of the French Chemical Society

THE French Chemical Society is holding its annual general meeting in Paris on June 15–17; at the same time it is commemorating the bicentenary of the birth of Priestley. Among the distinguished foreign visitors at the meeting are Sir William Pope, professor of chemistry in the University of Cambridge, who has been asked to preside over the opening meeting; Prof. Morgan, president of the Chemical Society; Prof. H. E. Armstrong; Prof. J. Böeseken, professor of organic chemistry in the Technical High School at Delft, who is speaking on the configuration of the polyalcohols; and Prof. E. Späth, professor of chemistry in the University of Vienna, who is discussing recent syntheses of alkaloids. An address on "Priestley and his scientific Work" was to be given on June 15 by Prof. C. Matignon, professor of inorganic chemistry in the Collège de France, and president of the Society. Priestley, by a decision of the National Council, was made a French citizen and was a member of the Academy of Sciences.

"Empire Forestry Handbook"

THE Empire Forestry Association has recently published a new edition of the "Empire Forestry Handbook" (Empire Forestry Association, Grand Buildings, Trafalgar Square, London. 5*s*.). The handbook contains much useful information, including a list of the officers and members of the Empire Forestry Association, and forestry officers serving in different parts of the British Empire. This is followed by a digest of education and research in forestry throughout the Empire, including lists of the universities and research institutes which contain forestry departments, together with the heads of departments and research workers. A list of forest periodicals is appended. The section on forest resources of the Empire contains a wealth of useful statistics concerning forest areas, and production, exports, etc., of conifers and hardwoods. The "Handbook" concludes with a list of the trade and botanical names of Empire timbers.

Lister Institute of Preventive Medicine

THE report of the governing body, presented at the annual general meeting of the Lister Institute of Preventive Medicine on May 24, gives a survey of the scientific work carried out during the year in the various departments. This includes studies on the viruses of variola, vaccinia, and varicella by Drs. Ledingham and Amies, on the typhus group of diseases by Dr. Felix, and researches on nutrition and vitamins in the Division of Nutrition under Dr. Harriette Chick. The nature and function of phosphoric esters formed during alcoholic fermentation have been studied by Prof. Robison and his collaborators. The National Collection of Type Cultures is housed in the Institute, and more than 5,000 strains of bacteria and fungi have been distributed to workers at home and abroad, and some 200 types have been added to the collection. The total expenditure for the year was £43,258, and the excess of income over expenditure £10,362.

National Institute for Research in Dairying

THE annual report for the year ending July 31, 1932, of the National Institute for Research in Dairying, University of Reading, which has only recently been issued, gives a summary of the research work carried out in the various departments. This includes a study of typical English milk, experiments on the feeding of young dairy cattle, and details of schemes for controlling the cleanliness of milk delivered by producers to retailers. Dr. H. Davenport Kay has been appointed to succeed the late Dr. Stenhouse Williams as director of the Institute. The financial position remains substantially the same as in the previous year, and additional income is still needed to stabilise the present position, and without reference to the ultimate needs of the Institute.

Franklin Institute Medals

AMONG the medal awards recently made by the Franklin Institute, Pennsylvania, are the following: Franklin medal, founded in 1914 by Mr. Samuel Insull, of Chicago, and awarded to those workers in physical science or technology whose efforts have done most to advance a knowledge of physical science or its application, to Dr. Orville Wright, of Dayton, Ohio, in recognition of the valuable investigations carried out by him and his brother, Wilbur, from which they obtained the first reliable scientific data concerning the principles of flight and the design of aeroplanes; and also to Dr. Paul Sabatier, dean of the Faculty of Science of the University of Toulouse, in recognition of his contributions to the general field of chemistry and especially to organic chemistry, in which he discovered the catalytic activity of finely divided common metals and devised methods for their use in science and industry; Elliott Cresson medal, founded in 1848 by Mr. Elliott Cresson, to Señor Juan de la Cierva, of London, in consideration of the original conceptions and inventive ability which have resulted in the creation and development of the autogiro.

Announcements

PROF. F. G. DONNAN, professor of general chemistry in the University of London, was elected an honorary member of the Bunsen Society at its thirty-eighth annual meeting held at Carlsruhe on May 26-28.

PROF. E. W. MACBRIDE, professor of zoology in the Imperial College of Science and Technology, has been appointed by the Development Commissioners to be chairman of their Advisory Committee on Fishery Research in succession to the late Prof. G. C. Bourne.

THE following appointments in the Colonial Agricultural Service have recently been made by the Secretary of State for the Colonies:—Mr. A. M. Gwynn, to be entomologist in the Department of Agriculture, Nigeria; Mr. C. L. Willding-Jones, to be assistant superintendent of agriculture, Gold Coast.

IT is announced in *Science* of May 19 that the Rumford medal of the American Academy of Arts and Sciences has been awarded to Dr. Harlow Shapley, director of the Harvard College Observatory and Paine professor of astronomy in Harvard University, for "researches on the luminosity of stars and galaxies".

IT is announced by Science Service that Commdr. Jerome Clarke Hunsaker, now vice-president of the Goodyear-Zeppelin Corporation, Akron, who designed the first modern airships produced in the United States, has been awarded the 1933 Daniel Guggenheim medal. Commdr. Hunsaker introduced aerodynamic research into American aircraft design by translating Eiffel's pioneer work and building the first wind tunnel at the Massachusetts Institute of Technology. He designed the *Shenandoah* airship and the first modern non-rigid airships in the United States. Since resigning from the Navy in 1927, he has played an important part in the production of the *Akron* and the *Macon*.

A DISCUSSION on "The Ionosphere", to be opened by Prof. E. V. Appleton, will take place at the Royal Society on June 22 at 4.30 p.m.

THE Masters' memorial lectures of the Royal Horticultural Society will be delivered in the lecture room of the Society's new hall in Greycoat Street, Westminster, on July 18 and 19, at 3.30 p.m., by Prof. V. H. Blackman, on "Plants in Relation to Light and Temperature".

IN 1920, Miss L. Jones-Bateman of Cae Glass, Abergele, presented to the Royal Horticultural Society a valuable silver-gilt replica of the Warwick Vase to be used for the encouragement of fruit production. It is accordingly decided to offer it triennially for researches in the growing of hardy fruits, figs, grapes and peaches in the open or under glass, and it is available for award in 1933. Candidates should submit accounts of their work by October 31 to the Secretary, Royal Horticultural Society, Vincent Square, Westminster, London, S.W.1.

THE life story of William and Caroline Herschel has been compiled from their journals and letters by Lady Lubbock, the granddaughter of Sir William Hershal, and will be published in July under the title "The Herschel Chronicle", by the Cambridge University Press. The book presents so far as possible in their own words, the astronomical discoveries of the Herschels.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An organiser of further education and a principal of the Stratford-on-Avon Technical and Art School—The Director of Education, 22, Northgate Street, Warwick (June 19). A chief sanitary inspector for the Municipal Commissioners, Penang—Messrs. Peirce and Williams, 1, Victoria Street, Westminster, S.W.1 (June 21). A University professor of pathology at the London (Royal Free Hospital) School of Medicine for Women—The Academic Registrar, University of London (June 23). A probationary forest officer for H.M. Forestry Commissioners—The Secretary, Forestry Commission, 9, Savile Row, London, W.1 (June 24). A lecturer in experimental psychology at the University of St. Andrews—The Secretary (June 24). A demonstrator in botany, interested in mycology, at King's College, Strand, London, W.C.2—The Secretary (June 27). A head of the Mathematics and Physics Department of the Liverpool Central Municipal Technical School—The Director of Education, 14, Sir Thomas Street, Liverpool, 1 (July 3). A junior assistant in the Electrical Engineering Department of the Royal Technical College, Glasgow—The Professor of Electrical Engineering (July 10). Examiners in various scientific subjects in the General and Higher School Examinations of the University of London—The Secretary to the Matriculation and School Examinations Council, University of London, South Kensington, S.W.7 (July 21). A professor of economics and commerce, and a professor of education at University College, Hull—The Registrar. A teacher of cookery at the Gloucestershire Training College of Domestic Science, Barrack Square, Gloucester—The Principal. A mechanical engineer for water works for the Government of the United Provinces, India—The High Commissioner for India, General Department, India House, Aldwych, W.C.2. A lecturer in botany at the Midland Agricultural College, Sutton Bonington, Loughborough.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Fine-Structure of the Ionosphere

I WAS much interested in the letter by Messrs. Schafer and Goodall in NATURE of June 3 dealing with the results of their experiments on the radio exploration of the ionosphere in the United States, since an independent set of observations in Great Britain, which are dealt with at length in a paper now awaiting publication, have led to very similar conclusions.

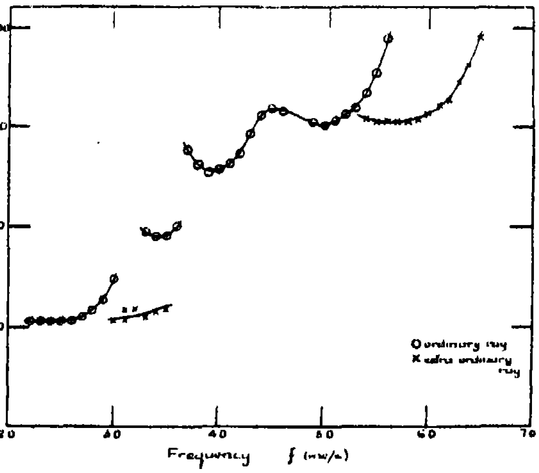

FIG. 1. (P^1, f) curve at 1200, April 8, 1933.

The method[1] used in the British series of observations has been to measure the maximum ionisation content of the various upper atmospheric regions by finding the critical penetration frequencies. Attention has been concentrated on the case of the ordinary ray of the two magneto-ionic components into which the incident wireless beam is resolved due to the influence of the earth's magnetic field. Such penetration frequencies are found from the inspection of a curve illustrating the relation between the equivalent path P^1 of the atmospheric waves and the frequency f. The maximum ionisation content N is then calculated from the formula

$$N = \frac{3}{2}\frac{\pi m}{e^2}f^2$$

where e and m are respectively the charge and mass of an electron and f is the critical penetration frequency.

The following results have been obtained from such determinations made at the Radio Research Station, Slough, in experiments carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

(1) Evidence has been found of the existence of a region of electrification intermediate between the two main regions E and F. (This has already been pointed out by my collaborator Mr. Naismith.[2]) The ionisation in this 'intermediate' region, as it may be called, is usually less than that in region E at noon but, in the early morning hours, as the solar rays begin to ionise successively lower strata of the atmosphere, it is noted more frequently. Our experience in this connexion is therefore different from that of Messrs. Schafer and Goodall.

(2) Evidence of the existence of a protuberance or ledge on region F has also been found, the maximum ionisation of which increases with solar altitude. Region F must therefore be regarded as composite.

A rather unusual (P^1, f) curve illustrating both phenomena is shown in Fig. 1 from which may be deduced the maximum ionisation contents (in electrons per cubic centimetre) as follows: region E, $1{\cdot}8 \times 10^5$; intermediate region, $2{\cdot}5 \times 10^5$; region F ledge, $3{\cdot}8 \times 10^5$; and region F main, $6{\cdot}1 \times 10^5$.

As previously stated, it is not usual in England for the intermediate region to be as strongly ionised as region E, so that the original division of the ionosphere into two main reflecting regions must still be retained. The most frequent daytime variation of ionisation with height appears to be that shown in Fig. 2. The British measurements do not, as do the American series, give the actual heights of the ionisation maxima, but they give the values of the maximum ionisation contents. The relative values of the ordinates of Fig. 2 are therefore approximately correct but not the relative values of the abscissæ.

The British series of observations suggests therefore that there are four main components in the ionosphere caused by the influence of ultra-violet light from the sun. Such a composite structure is not considered unlikely when it is remembered that Pannekoek[3] has shown that the level of maximum ionisation caused by ultra-violet radiation depends on the ionisation potential of the gaseous constituent. It is tempting to associate the four components with the four ionisation potentials of oxygen and nitrogen atoms and molecules, and the suggestion that F^{II} is due in this way to oxygen atoms and F^{I} to oxygen molecules has, indeed, already been made by T. L. Eckersley[4], who independently obtained evidence indicating a dual structure for region F.

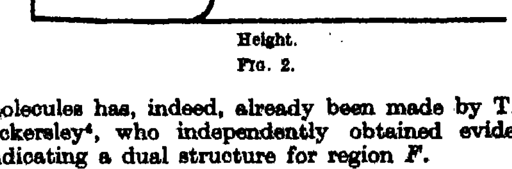

FIG. 2.

Concerning the subject of nomenclature, reasons are given in my paper for adopting the one indicated in the diagram. The suggestion of Messrs. Schafer and Goodall that the intermediate region should be called the M region, while acceptable in other ways, may perhaps lead to confusion in one respect; since an M region reflection might be mistaken for what Ratcliffe and White have, very appropriately, called

M reflections (that is, tracks of waves which have been reflected in succession from region *F*, the upper part of region *E*, and region *F* again before coming back to the ground). For that reason the term 'intermediate region' seems preferable.

E. V. APPLETON.

Halley Stewart Laboratory,
King's College,
London.
June 3.

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[1] NATURE, 127, 197, Feb. 7, 1931; see also *Proc. Roy. Soc.*, A, 137, 36; 1932.

[2] *J. Inst. Elec. Eng.*, 72, No. 435, 246; 1933.

[3] Pannekoek, *Amst. Acad. Proc.*, 29, 1165; 1926.

[4] Eckersley, *J. Inst. Elect. Eng.*, 71, No. 429, 423; 1932.

WE were much interested in the letter of Messrs. Schafer and Goodall in NATURE of June 3, p. 804, under the title "Characteristics of the Ionosphere", and in particular in their remarks about the presence of an ionospheric reflecting region between the *E* region and the *F* region of Appleton. While making automatic records of ionospheric reflections[1] we have recently found indications of this region on several occasions.

One of our records, for the morning of January 29, 1933, taken on a wave-length of 150 m., is reproduced in Fig. 1. On this occasion a "circularly polarised receiver"[2] was used, and was arranged so as to receive left- and right-handed circularly polarised waves alternately; a black line at the upper edge of the record corresponds to the reception of right-handed polarisation. At 0655 G.M.T., reflection of the right-handed component at the *F* region begins, at 0712 G.M.T. the left-handed component appears, at 0735 G.M.T. the right-handed component 'jumps' to the intermediate region at a height of 175 km. and at 0750 G.M.T. it disappears due to absorption. At 0835 G.M.T. the left-handed component 'jumps' to the intermediate region and a double reflection from the intermediate region is recorded. At 0930 G.M.T. a discontinuous 'jump' from the intermediate to the *E* region is seen, and for a few minutes reflections from the two regions occur simultaneously. A little later double reflections from the *E* region appear.

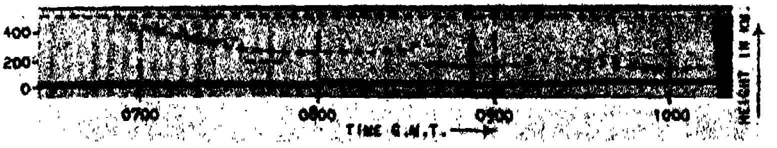

FIG. 1.

The sudden jumps from *F* to the intermediate region, and from the intermediate to the *E* region, indicate clearly that the three regions are distinct, while the fact that the jump from the *F* to the intermediate region takes place at different times for the right- and the left-handed components shows that the intermediate region is mainly composed of electrons.

J. A. RATCLIFFE.
E. L. C. WHITE.

Cavendish Laboratory,
Cambridge.
June 7.

[1] Ratcliffe and White, *Proc. Phys. Soc.*, 45, 399; 1933.

[2] Appleton and Ratcliffe, NATURE, 130, 472, Sept. 24, 1932.

The Hydroxyl Group and Soap Film Structure

IN view of the well-known 'stabilising' effect of glycerin on soap solutions, it is not surprising to find that the elastic recoil of aqueous ammonium oleate—demonstrated by Hatschek at a Royal Institution discourse in 1927[1]—is destroyed by a small addition of glycerin: the resulting solution having no obvious anomalous viscosity. (Hatschek supported a hollow glass cylinder on vertical pivots in a quarter per cent solution of ammonium oleate: when this cylinder was spun by the finger and thumb, it rotated for a few seconds, but then, after stopping, slowly returned in the opposite direction, as if by a coiled-up spring.)

Besides glycerin, many other alcohols, however, have an even more striking effect on aqueous ammonium oleate, sufficiently interesting to place on record. The mucilage-like consistency of 9 per cent ammonium oleate is changed by small additions of glycol, propylene alcohol, cyclohexanol, and ordinary ethyl alcohol, among other substances, first to a thick but perfectly clear gel, transforming in a short time, or on further small addition of the alcohol, to a limpid, free-flowing, normal, clear liquid. The actual amounts that produced this result, when added to 20 c.c. of 9 per cent aqueous ammonium oleate, were 4·5 c.c. glycerin, 2·8 c.c. glycol, 1·1 c.c. propylene alcohol, 0·5 c.c. cyclohexanol, and 1·2 c.c. ethyl alcohol. The resulting solutions, especially when diluted, give lasting thin films which have in most cases the interesting property of thinning to the 'black' state through several grades, so that ordinary photographs of three or four well-defined black grades can often be obtained present at the same time, though aggregating at different rates.

This reaction would also suggest that soap molecule aggregates are formed by means of hydroxyl groups rather than as ordinary hydrates; and seems to indicate a mechanism by which sheets of such molecules are rooted in a water surface, or linked in a stable soap film. In any event, the addition of alcohols as described here has evidently resolved some of the complications of the colloidal structure of the aqueous oleate.

W. J. GREEN.

Royal Institution, W.1.
May 18.

[1] *Proc. Roy. Inst.*, 25, 245; 1926-28.

Interaction between Soot Films and Oil

THE effect described by Mr. J. H. Coste in NATURE of May 13, p. 691, is a manipulation variation of the interaction reported by me in NATURE of March 12, 1932, p. 401, as a new observation.

The drop *falling* on the film, the result is a record of impact rather than the effect of an undisturbed interaction. The drop being carefully *posed*, the central dark zone, varying from 0·25 cm. to 0·5 cm. in diameter, is a beautiful self-contained ring system, of so small diametrical variation that microscopic examination is necessary. A minute clear-dot puncture circle—probably through faulty posing—sometimes occurs, like a planet on the zone centre with perhaps a dozen surrounding satellites. This puncture circle increases with increased distance of fall, and at 3 mm. is quite large, whilst at 3 cm.

the dark zone is completely split into the striking spectacular visible effect noticed by Mr. Coste. This is an impact effect, the beautiful microscopic ring system obtained by the orderly reaction when the drop is posed being totally destroyed. Excepting possible central punctures, there is continuity throughout the system, and no film displacement forming 'clots' of carbon if the drop be posed, but a pleasing gradation of visible light and dark zones without suggestion of strain. A striking visible pattern persists outside the central dark zone, revealing microscopically orientated strings of carbon particles (or agglomerates) of denser or rarer conformation, with gradient transition between rings.

The striking periodic motive throughout a diameter of 2–3 cm. when the drop is posed, contrasts with the destroyed periodicity in the dark zone—only irregularly propagated outside—produced by falling impact.

The viscosity, vapour pressure, manner of introduction, and 'setting' rate of drop material seem to decide overall diameter. If too viscous, the film is plucked away; if too mobile, too rapid spread with but transitory system formation occurs. High, but not too high, viscosity produces best results and, amongst many other substances tried, a brand of immersion oil, whilst the soot film should be neither too patchily thin nor obscuringly dense.

If Mr. Coste decides to try posing the drop, as first used, he will surely find enhanced beauty due to interaction but slightly impeded by impact, and the setting-up of well-marked periodicity.

S. C. BLACKTIN.

312, Ringinglow Road,
Sheffield, 11.
May 18.

Vitamin C in the Adrenal Gland

A NUMBER of attempts have been made to obtain cytological preparations of vitamin C in the adrenal, based upon the well-known reducing power of the vitamin (ascorbic acid)[1].

The solubility of vitamin C in water makes it impossible to use the customary fixatives. In this work fixation was therefore accomplished by suspending pieces of the gland in the vapour of formaldehyde, obtained by heating paraformaldehyde. The gland tissue fixes rapidly and well by this method.

The method of demonstration which gave the best results was the impregnation of the gland using silver nitrate[2]. This gave good, though erratic, results. Following fixation, the gland was placed in 2·75 per cent solution of silver nitrate for twenty-four hours. Further methods using alcoholic silver nitrate of various strengths gave varying results.

In the mouse adrenal the cortex first stained an intense black and after two or three hours the medulla also became black. Paraffin sections of the gland showed cortex and medullary cells to contain large numbers of very small brownish black granules. The usual tendency towards surface tension aggregation at membranes was present, with the result that the nucleus was practically obscured by the mass of granules surrounding it. The cytoplasm of the cell was bordered by aggregations of these granules, and a number were scattered through the cytoplasm itself. Fig. 1 illustrates the arrangement of the granules within the cell. The cortex exhibited this reaction in patches, but the medulla showed an even impregnation, without the tendency to aggregation at membranes that was present in the cortical cells.

In the adrenal gland of the cat the peripheral cortical cells (zona glomerulosa and outer zona fasiculata) tended to impregnate more strongly than the inner cortical cells and the medulla. This was not due to imperfect penetration as the gland was cut up into a number of transverse portions for impregnation.

Guinea-pig adrenals showed impregnation of both cortex and medulla.

In the adrenals of the animals used in this work a number of cortical cells were packed with globules (lipoidal ?) and the granules of vitamin C were aggregated around the edges of the globules, presumably due once more to surface tension action.

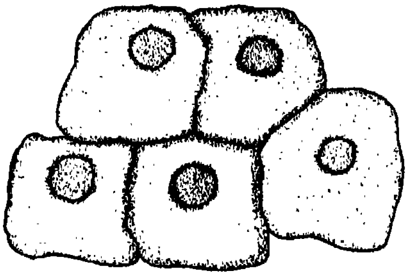

FIG. 1.

As a control, a number of pieces of adrenal gland were soaked in water for an hour, thus allowing the vitamin C to dissolve out. There were no black granules present in the material on subsequent examination.

GEOFFREY BOURNE
(Hackett Research Student).
Department of Biology,
University of Western Australia.
April 24.

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[1] Szent-Györgyi and Haworth, NATURE, 131, 24, Jan. 7, 1933.
[2] Compare Szent-Györgyi, *Biochem. J.*, 22, 1393; 1928.

Carbonic Anhydrase and the State of Carbon Dioxide in Blood

MANY physiologists hold that sodium bicarbonate is the main form in which carbon dioxide is carried in the blood, and that the elimination of the latter in the lungs is due to the reaction

$$\text{HP[representing the weak protein acids of the blood]} + \text{NaHCO}_3 \rightleftharpoons \text{NaP [protein salt]} + \text{H}_2\text{CO}_3 \qquad \text{(i)}$$

followed by

$$\text{H}_2\text{CO}_3 \rightleftharpoons \text{CO}_2 + \text{H}_2\text{O} \qquad \text{(ii)}$$

Reaction (i) is very fast, but reaction (ii) is known to be slow. Calculations by Henriques[1] and others show indeed that (ii) is too slow to explain the observed rate of CO_2 escape in the expired air. Either then there must be a catalyst for reaction (ii) in the blood, or else some quite different chemical mechanism must operate.

The factor catalysing the $H_2CO_3 \rightleftharpoons CO_2 + H_2O$ *reaction.*

Following on the work of Hawkins and Van Slyke[2], and Brinkman and Margaria[3], we[4] isolated in 1932 from ox-blood, a white substance of which 1 in 10,000,000 is active. This extract is a typical enzyme, and since it seems to be distinct from other known enzymes, has been christened 'carbonic anhydrase'.

A second mechanism. Direct combination of CO_2 with proteins.

Such compounds (possibly of a carbamate type) have been suggested by Bohr, Buckmaster, Mellanby and lately Henriques. Their detection in normal blood is hindered by the presence of the carbonic anhydrase, but by poisoning the latter by addition of *M*/10 HCN we have found new and clear-cut evidence for their existence.

(*a*) If such cyanide blood (free of CO_2) is shaken with CO_2, there is first a rapid uptake followed by a long slow one. The latter is due to the reaction $CO_2 + H_2O \rightarrow H_2CO_3$ which in absence of catalyst proceeds slowly. In the rapid stage much more CO_2 is taken up than can be accounted for by mere physical solution. The excess must be due to a chemical combination, which is *not* bicarbonate.

(*b*) Ammonia, glycine and peptide solutions behave just like the cyanide-blood. The CO_2 uptake in the rapid stages is in all these cases much increased by alkalinity and by lowered temperature. For the simpler NH_2 containing compounds (ammonia, etc.) it is certain that the compound so formed is a carbamate, that is,

$$RNH_2 + CO_2 \rightarrow RNHCOOH$$

So it seems extremely probable that the same is true of the cyanide-blood also.

(*c*) At 0° C. and physiological *p*H, 10–20 vols. per cent CO_2 are taken up in this carbamate-like form by cyanide blood, when the gas phase contains 40–50 mm. CO_2 pressure.

(*d*) In reduced blood, the carbamate-like compound, at CO_2 pressures from 20–60 mm. mercury amounts to about 5 vols. per cent more (measured as c.c. CO_2) than in the case of oxygenated blood, thus suggesting that hæmoglobin is the chief blood protein concerned. At 15° C the difference is almost as large, but the absolute amounts are much less. Since controls suggest that the only effect of this cyanide is to poison the carbonic anhydrase, we must suppose that these carbamate-like compounds are also present in normal blood and hence are important both in experiments on blood at 15° C and below, and also in CO_2 transport by cold-blooded animals.

(*e*) At mammalian body temperature (37° C) the carbamate-like compounds must, owing to the temperature effect noted above, be much less in amount. Some, indeed, of the difference between those physiologists who have upheld the bicarbonate mechanism as the sole mode of CO_2 carriage, and those who have supported a direct combination of CO_2 with the blood proteins may be due to the former usually having worked at 37° C and the latter at 15° C or below. We are at present extending our work to 37° C so as to assess the rôle of carbamate-like compounds in mammalian CO_2 transport.

Finally we would emphasise again that the formation of these carbamate-like compounds is quite distinct from the bicarbonate mechanism and, unlike the latter, does not seem to be catalysed by carbonic anhydrase.

N. U. MELDRUM.
F. J. W. ROUGHTON.

Physiological and Biochemical Laboratories,
Cambridge.
May 8.

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[1] Henriques, *Biochem. Z.*, 200, 1; 1928.

[2] Hawkins and Van Slyke, *J. Biol. Chem.*, 87, 265; 1930.

[3] Brinkman and Margaria, *J. Physiol.*, 72, 6P; 1931.

[4] Meldrum and Roughton, *J. Physiol.*, 75, 8P; 1932.

The Astronomical Radiative Stability

SIR JOSEPH LARMOR in his letter in NATURE of June 3 concludes that because the temperature of the earth's surface has never changed by 50° C. in excess or defect of its present value since the commencement of organic evolution—as that would have destroyed all organic life—the effective temperature of the solar radiating surface cannot have changed from its present mean value, 6,000° K., by 1,000° in excess or defect.

This conclusion is based on the erroneous assumption that the temperature of the earth's surface reacts to a change in solar radiation like a black body able to radiate into free space. The reality is entirely different, for the surface is surrounded by an atmosphere of water vapour which is extremely opaque to long-wave terrestrial radiation, and the temperature of the earth's surface plays only a subordinate part in the balance of incoming solar radiation and outgoing terrestrial radiation. I discussed the question of the balance of solar and terrestrial radiation in a paper published in 1928[1], taking into account the selective absorption of water vapour and the actual temperature existing in the earth's atmosphere.

One of the chief results of the investigation was to show that, if the solar radiation increased, there would be an initial rise of temperature, but that this would lead to an increase of cloud amount which would reflect the short-wave solar radiation, and the balance would be reached by increased reflection and not by increased temperature. I gave reasons to believe that the results of increasing or decreasing the solar radiation within very large limits would be mainly an increase or decrease of cloud, the temperature changes being relatively small. This conclusion was supported by a calculation which showed that if the solar radiation decreased to three-fifths of its present value, clouds would entirely disappear, while if it increased to twice its present value, the sky would be completely overcast. As it happens, Mars and Venus, both planets with water vapour in their atmospheres, are respectively at such a distance from the sun that they receive a half and double the amount of solar radiation received by the earth, and the former has no clouds and the latter is completely cloud covered.

The limits of solar variation discussed by Sir Joseph Larmor, ± 1,000°, are those which would correspond with halving and doubling the solar radiation: and would therefore be compensated by varying the amount of cloud from no clouds to overcast skies, with relatively small changes of temperature. Instead of Sir Joseph's conclusion that such variations of solar radiation have never taken place, there is good reason to believe that changes of solar radiation of this magnitude are of relatively recent occurrence. More and more evidence is being found that, during the Pleistocene period, there were several large variations of rainfall simultaneously all over the earth[2]. Evidence of two pluvial epochs and two dry epochs is found in most regions, and the advance and retreat of the ice, which were characteristics of this geological period, were secondary effects of the changing precipitation. The variation in the precipitation between a dry and a pluvial epoch was very great, much greater than is generally realised. The average rainfall during the pluvial epochs was probably four or five times the present rainfall, and as the precipitation extended over most of the present deserts, the sky was probably nearly overcast in all parts of the world. This could only have been brought about by a very large increase of solar radiation.

G. C. SIMPSON.

Meteorological Office,
London.
June 6.

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[1] "Further Studies in Terrestrial Radiation", *Mem. Roy. Met. Soc.*, **3**, No. 21; 1928.

[2] "The Climate during the Pleistocene Period", *Proc. Roy. Soc. Edin.*, **50**, 262; 1930.

Origin of Tektites

DR. L. J. SPENCER'S contribution to NATURE of January 28, on the "Origin of Tektites", has interested me greatly, especially for the reason that his views tend to support that of the late Prof. J. W. Gregory and my own, as to the terrestrial origin of the australites. Dr. Spencer's explanation, however, does not appear to account for the occurrences and shapes of these australites, for the bomb-shaped ones have undoubtedly received their form by a spinning action, and not by a mere fusion of the sand covering the continental duricrust. Moreover, the australites are found in every State of Australia, and where they are abundant there is at present no evidence of meteoritic falls.

We may readily conceive how whirling dust in cyclonic storms, such as are known to take place in Australia, might be fused by the discharge of the lightning which often accompanies these electric storms.

The experiments of Prof. C. V. Boys on the discharge of electric sparks through molten resin tend to confirm this latter opinion, for he produced by this method many of the forms that are found in australites.

F. CHAPMAN.

National Museum,
Melbourne.
April 5.

MR. CHAPMAN'S theory of the origin of tektites, which is explained in detail in his book "Open-Air Studies in Australia" (1929), is one of the many contributions to this problem, and was mentioned in my article. But no tektites (aerial fulgurites) have been picked up after the discharge of lightning through dust-storms. On the other hand, bodies with a very close resemblance to tektites have been collected around the meteorite craters at Henbury in Central Australia and at Wabar in Arabia—at Henbury for a distance of a mile from the main crater. 'Bombs' of molten silica must have been ejected from the craters by the violent gaseous explosions, and spinning through the vapours they collected condensed silica with some iron and nickel on their surface. A test for nickel in australites will help to decide between the rival theories.

L. J. SPENCER.

British Museum (Natural History),
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May 9.

The "Leeds Portrait" of Joseph Priestley

SOME time ago, I came across a photographic copy of an early portrait of Joseph Priestley among the Canton papers in the library of the Royal Society.

According to H. C. Bolton in his "Scientific Correspondence of Joseph Priestley", the original portrait was at one time owned by Mrs. Bilbrough (née Ellen Priestley) and in 1787 it was taken by Mrs. Crouch (Priestley's sister) to Gildersome, near Leeds, where she lived as housekeeper to William Hudson, a local resident. It is this association with Leeds which has presumably caused it to be known as the "Leeds portrait". How long it remained at Gildersome is not known, but it was photographed in 1860 by Messrs. Caldesi, Blanford and Co., 13, Pall Mall East, London. Since that time, the original appears to have been lost sight of and no reproduction of the portrait has hitherto been published.

It is of particular interest in that it is the earliest known picture of Priestley, representing him at the age of thirty years (1763) as he appeared during the first part of his stay at Warrington. It was at this stage of his career that he was introduced to scientific circles in London during a Christmas holiday in 1765, when he made the acquaintance of John Canton and Benjamin Franklin, who were mainly responsible for his election as a fellow of the Royal Society in the following June. It was to them that he owed his first interest in original research, which he undertook in order to prepare the way for his "History and Present State of Electricity" published early in 1767. No other Priestley portrait dates from this important period of his life.

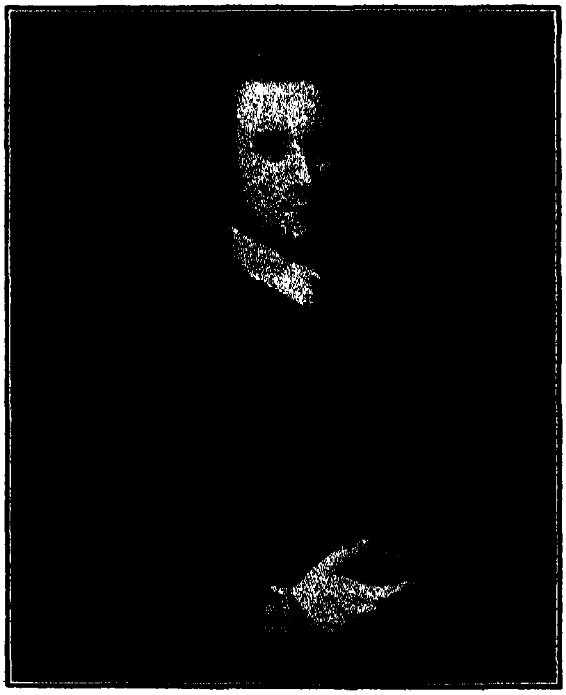

FIG. 1.

The Royal Society copy, from which the accompanying print (Fig. 1) has been reproduced with the permission of the Council of the Society, was evidently incorporated in the Canton collection by Dr. James Yates because of Priestley's friendship with Canton between 1765 and the latter's death in 1772. Two other Caldesi, Blanford prints are known to exist; one in the Timmins' Collection in the Reference Library, Birmingham; the other in the United States.

I shall be glad to hear of the existence of other copies of this photograph and I shall especially welcome any information which may lead to the finding of the original.

W. CAMERON WALKER.

History of Science Department,
University College,
London, W.C.1.
May 31.

Crystal Structure and Orientation in Thin Films

IN crystal growth, the well-known phenomenon of pseudomorphism extends to all three dimensions. Recently we have found that thin films of aluminium on platinum, of zinc oxide on zinc and of magnesium oxide on magnesium possess abnormal crystal structures. For example, aluminium, normally of face-centred cubic structure ($a = 4·05$ A.), when deposited as a sufficiently thin layer on face-centred cubic platinum ($a = 3·91$ A.) acquired a face-centred tetragonal structure with basal axis 3·90 A. and major axis 4·02 A. Thus, in its basal dimensions the aluminium was pseudomorphic with the platinum substrate. A similar effect was observed in the case of a thin film of zinc oxide on zinc (triangular close-packed lattice, $a = 2·685 \pm 0·002$ A.; $c = 1·86$). In this case, whilst the basal dimensions of the zinc oxide were similar to those of the zinc substrate, the major axis had increased from 5·178 A. (normal zinc oxide) to 6·873 ± 0·002 A. Thus, the volume of the abnormal zinc oxide cell, basally pseudomorphic with normal zinc, was nearly equal to that of the normal zinc oxide cell.

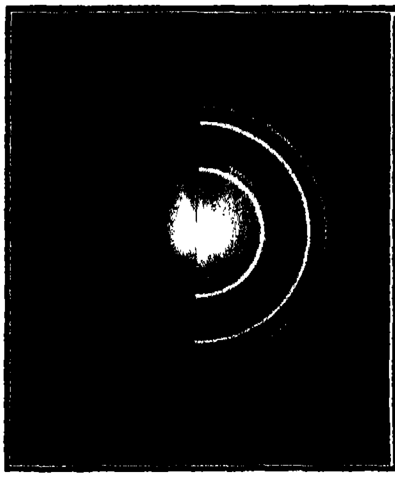

FIG. 1.

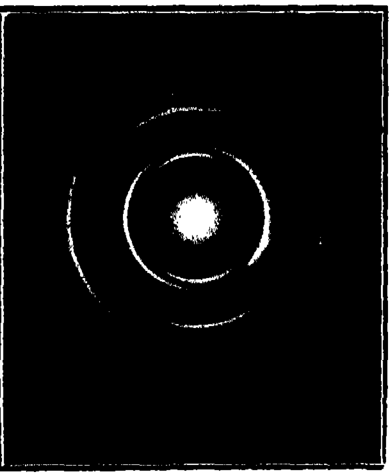

FIG. 2.

Owing to deep penetration, the intensity distribution between the rings of X-ray diffraction powder photographs is of great assistance in their analysis, because the ring intensities may be taken as being proportional to the atom densities of the corresponding planes. Hitherto it seems to have been generally supposed that this practice can be extended to electron diffraction analysis and that orientation must result in a splitting-up of the rings into arcs. Owing to the limited penetrating powers of electrons, however, it is quite conceivable that such a view might lead to serious errors in analysis. Consider, for example, a diffracting film consisting (to take the most symmetrical case) of cubic crystals orientated with two axes normal to the electron beam, the crystal array being otherwise completely random. Rings due to (x, y, z) planes, where x, y and z are integers, will be missing from the pattern, which will consist solely of rings due to planes parallel to the beam axis, that is $(x, y, 0)$, $(0, y, 0)$ and $(x, 0, 0)$ planes. With gradual departure from this ideal case, diffraction will also occur from (x, y, z) planes, where z is large compared with x and y, but the intensity distribution between the rings will remain abnormal until all trace of orientation has disappeared. That such cases of orientation can and do occur may be illustrated by the following results:—

The electron diffraction pattern, *A* (Fig. 1), was obtained by transmission through a thin film of partially oxidised zinc. The reference pattern[1], *B*, was due to normal zinc oxide ($a = 3·220$ A.; $c = 1·608$) with random disposition of the crystals. Analysis of *A*, based solely on ring diameters, showed that the specimen consisted of normal zinc oxide together with small amounts of normal zinc ($a = 2·685 \pm 0·002$ A.; $c = 1·86$) and basally pseudomorphic zinc oxide ($a = 2·686 \pm 0·002$ A.; $c = 2·56$). On comparison of *A* with the reference pattern it will be seen that many normal zinc oxide rings are either absent or much weakened, whilst others are greatly intensified. For example, rings due to planes parallel to the basal planes of the hexagonal crystals are missing, whereas those produced by the $(x, y, 0)$ planes are abnormally strong. These facts show that the normal zinc oxide crystals in the specimen were orientated in such a manner that their bases were normal, or nearly so, to the electron beam axis, the directions of the basal axes, however, being completely random.

The pattern (Fig. 2) was obtained from a similar film which had been stretched. Whilst the composition of the film (normal zinc oxide, zinc and pseudomorphic zinc oxide) remained unchanged, the distribution of intensities between the rings is now entirely different, and the rings tend to break up into arcs. Comparison of the relative ring intensities with those of the reference pattern, *B* (Fig. 1), shows that, whilst some of the crystals were orientated as in the previous case, others were now disposed in such a manner that two rectangular faces of each crystal were normal to the beam axis. Moreover, the tendency of the rings to break up into arcs shows that the major axes of these crystals were orientated about the direction of stretch of the film.

G. I. FINCH.
A. G. QUARRELL.

Imperial College of Science and Technology,
London, S.W.7.
May 30.

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[1] NATURE, 131, 842, June 10, 1933.

'Bull-Dog' Calf in African Cattle

THE achondroplasia-like condition which gives rise to the 'bull-dog' calf is not uncommon in certain breeds of cattle, notably in the Dexter, in which it has been shown to have a definite genetic basis and to be due, possibly, to a retardation in the functioning of the pituitary during fœtal life (Crew[1]). In the Norwegian Telemark breed, Wriedt[2] has described a very similar condition which, however, is different genetically. It has also been reported in the case of the sheep (Crew and Roberts[3]).

The purpose of this note is to record the fact that the 'bull-dog' calf occurs in cattle indigenous to Africa. The first case came to my notice in April 1929 and occurred on one of the few farms in Uganda owned by Europeans. Since then no fewer than twelve other monsters have been born, all of which presented the same characteristic abnormalities which justify the appellation 'bull-dog'. The specimens examined by me were quite typical of the condition as described by Crew, and every one of them occurred in Nganda cattle which are of a definitely fixed type and, so far as I can ascertain, breed true. They are supposed to have originated from a cross between the Ankole and the Eastern Province cattle. The Ankole cattle are characterised by their enormous horns, up to 6 ft. in span, leggy stature, and by the absence of hump, whilst the Eastern Province animals are typical zebus of small size. The Nganda cattle have medium-sized horns and a small hump. Buganda, the area in which these Nganda cattle are to be found, lies between Ankole on the western side and the Eastern Province to the east of the Nile. Although the owner of the farm on which these 'bull-dogs' occurred had cattle of all three types (Ankole, Eastern Province and Nganda) it was only the latter breed which produced them. Of the twelve which have been born since 1929, all save one were first calves. One of them was born alive but was killed after a few hours.

The Bahima, the pastoral tribe of the Ankole district in the west of Uganda, are employed as herdsmen, and unquestionably it is known to them that such 'bull-dog' calves are not uncommon. But it is impossible to obtain any information as to their incidence in the tribal herds for the reason that the monster is regarded as an omen of bad luck to the herd and to its owners. Some of the herdsmen would not even look at the 'bull-dog' calf, and the opinion prevails that if a woman of the tribe sets eyes on it she is bound to become bewitched and to produce a similar abnormality herself. So it is that, though the 'bull-dog' calf is probably fairly common among the cattle of the Western and Buganda Provinces, one hears nothing of them. They are got rid of quickly and never mentioned. This is the reason why the 'bull-dog' calf is never encountered in herds owned by natives: it was only because these cattle were owned by Europeans that I am able to record their occurrence in Nganda cattle.

J. CARMICHAEL.

Grange Close,
Ripon,
Yorkshire.

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[1] Crew, F. A. E., "The significance of an achondroplasia-like condition met with in cattle", *Proc. Roy. Soc.*, B, 95, 228–254; 1923.

[2] Wriedt, Chr., "Letale Faktoren", *Z. Tierz. Zücht.*, 3, 223–230; 1925.

[3] Crew, F. A. E. and Fraser Roberts, J. A., "The genetics of the 'sheep'", *Bibl. Genet.*, 2, 263–286; 1925.

Distribution of Nitrates in the Soil and Root Development in Coffee

IN the course of some preliminary investigations, after rains, upon the distribution of nitrates in the lower levels of a Kikuyu lateritic red loam, upon which coffee was growing, it was found that the curve showing distribution with depth was always of the form shown in Fig. 1. As the surface soil dried with drought, the nitrate content decreased, in some cases to so little as five parts per million, but the general shape of the curve remained the same, rising, generally, to a level of about forty parts per million, samples being taken at every foot to a depth of 8-12 ft.

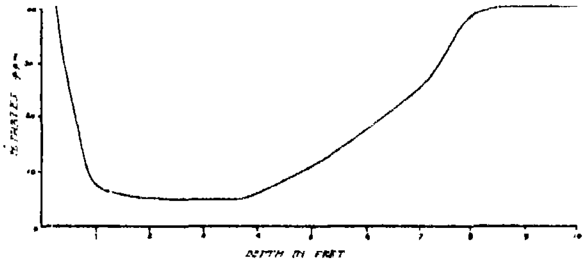

FIG. 1.

Comparing the curves of nitrate distribution with graphs of root distribution, it appears that the zone of low nitrate concentration coincides with the zone of vigorous development of root growth, that is, the coffee bush does obtain a substantial part of its nitrogen requirements from the lower levels of the soil. This investigation is being extended, but in the meanwhile it would be interesting to learn if any similar observations have been made in connexion with other fruit trees or crops. No references can be found in our limited library.

V. A. BECKLEY.
F. MCNAUGHTAN.

Scott Agricultural Laboratories,
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April 19.

Neutron, Proton and Positron

THE neutron is usually looked upon as an aggregate of a proton and an electron. If it were so, there ought to be a strong tendency for hydrogen atoms to be converted spontaneously into neutrons, and the number of neutrons present in the universe should be much higher than it is assumed to be. I suggest that *the proton be considered as an aggregate of a neutron and a positron*. The neutron would be looked upon as an elementary material corpuscle without electric charges altogether. The proton would be able to dissociate into a neutron and a positron.

The very small number of neutrons and positrons met with in the universe would then be easily explained by the fact that the dissociation of protons requires a large quantity of energy and is by no means spontaneous.

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May 10.

Research Items

'Diffusion' and Disease. An argument in favour of Dr. Paul Rivet's theory of the Oceanic origin of certain of the Indian peoples of America has recently been deduced from the character and distribution of typhus by Dr. Charles Nicolle (*J. Soc. Américanistes*, S. 2, 24, fasc. 3). Two distinct forms of typhus are now recognised. The older and classical form is found in man only, is carried by lice and has a distribution which is confined to the Old World, where it extends from Europe, through North Africa (but is not found in the tropical area) to western and central Asia and China. Although rats can be inoculated they are found not to be carriers, and are free from the virus after they have recovered from the fever. The second form has been identified as a disease of the rat, which is communicable to man, and is endemic in America. Its distribution, though not yet exactly determined, seems to be confined to America and the coastal parts of eastern Asia—Malaysia—Australia and New Zealand. It may be that eventually it will be found to embrace all parts. This form of typhus could not have been introduced into America by the Norsemen, as the carrier, the grey rat, was not then known west of the Urals; yet the disease was prevalent in America before the Spanish conquest, as is recorded by the chroniclers. As the rat could scarcely have accompanied the original migrations of the Indians over the inhospitable northern lands and also typhus does not occur in Alaska, one route alone remains, namely, that from Oceania, the rats having been carried on the canoes of the immigrants. There is evidently need of inquiry into the types of rats and of their parasites in Polynesia.

Prehistory of South-East Asia. An account of the search for evidence of prehistoric man in Siam, and of certain conclusions to be drawn therefrom, is given by Dr. Fritz Sarasin in *L'Anthropologie*, 43, Nos. 1–2. Siam, in contrast to Indo-China and Malaya, has furnished little evidence of prehistoric man, owing in part to the fact that the country is thickly covered with virgin forest, in part to the occupation of the caves, in which such evidence might be sought, by Buddhist shrines or by hermits. A number of caves were inspected in both the northern and southern extremities of the chain of low hills which traverses the country. Several of them, where the paving usual in such shrines did not cover the whole floor, yielded a number of implements of palæolithic type; and in one secondary cave trenches were dug. Here bed rock was reached at a depth of 1·6 m., through 20 cm. of sand, 80 cm. of loamy soil, tinted grey by ash, and containing pottery and crude implements of palæolithic type, round hammer-stones, fragments of red ochre and broken bones, and below these yellow earth with no traces of human occupation. Comparison of the material obtained with evidence from Indo-China and Malaya leads to the conclusion that in the archæology of south-east Asia it is possible to distinguish: (1) a palæolithic culture of a simple and very primitive type without any indication of polished implements, represented in the archaic Hoabinhian of Tonkin, the Siamian of Siam, and the Malayan Linggong culture, its age, probably, being miolithic (Menghin); (2) a debased palæolithic with isolated proto-neoliths in juxtaposition and no pottery, represented in middle Hoabinhian, the older Bacsonian of Kéo-Phay, and the lower deposits of Gua Kerbau in Perak, of later age than (1); (3) a culture which is still palæolithic in its principal characters, but with an increased number of polished implements and greater refinement in form, pottery appearing; represented in upper Hoabinhian and Bacsonian and the upper deposits of Gua Kirbau, its age epimiolithic (Menghin); (4) full neolithic. The palæolithic of south-east Asia is certainly post-glacial and, therefore, relatively recent.

Relationships of the Mammals of Vancouver Island. E. Raymond Hall lists twenty kinds of mammals from Vancouver Island, British Columbia (Univ. California Pub. Zool., 38, 1932, p. 415). Four are new subspecies, including a Vancouver Island wolf (*Canis occidentalis crassodon*), and the brown rat has been introduced. Comparison of this mammalian fauna with the faunas of the mainland and Alaska shows that, structurally, nine of the kinds have their closest relatives on the mainland of southern British Columbia, while six others more resemble forms which occur in south-eastern Alaska. On the whole, the insular fauna seems to have almost equal affinity with Alaska and with the proximal mainland in British Columbia.

Gorgonacea from the Great Barrier Reef. Prof. Sydney J. Hickson, in reporting on the Gorgonacea from the Great Barrier Reef Expedition 1928–29 (*Sci. Rep.*, 4, No. 13, 1932. British Museum (Natural History)) is in agreement with the naturalists of the expedition that gorgonids are rare on the Barrier Reef. In one locality investigated, however, he finds these corals are richly represented. This is the Penguin Channel lying between Snapper Island and the mainland, a short and narrow channel about one mile north-west of Low Island and about 13–14 fathoms deep, where no less than 42 specimens, belonging to 19 genera and 15 species, were obtained. The conditions in this channel are peculiar, with a flow of water in one direction over a rocky bottom and apparently very favourable to the growth of the Gorgonacea. This is entirely different from Panama Bay, where Prof. Hickson (1928) described the Gorgonacea as flourishing in an open and very muddy sea. There are no species common to the two regions although certain forms of ramification occur in both. The enormous variability of many species has not been sufficiently recognised and the spicules are found to vary so much in some genera that it is not safe to use them as specific characters. Careful examination of a number of specimens shows that many so-called species are really only local varieties of a much smaller number. The general forms of the ramifications are regarded as good characters for systematic determinations. The author also considers that colour may be of much value in systematic work, the pigment which colours the spicules being either present or absent. The species without any colour in any of the spicules are apparently distinct from those with colour in some or all of the spicules. From the few observations on the gonads the facts seem to indicate that most are in approximately the same stage in February and spawned later, perhaps in June and July.

Disposal of Debris by Blood-Vessels. Science Service reports that, at the meeting in Cincinnati, on April 12–13, of the Federation of American Societies for Experimental Biology, Drs. E. R. Clark and E. L. Clark of the University of Philadelphia reported further observations on the thin layer of tissue in a rabbit's ear which they have examined microscopically through two thin transparent windows. Their recent work has been directed to the solution of the problem as to how the body disposes of debris cast out of the blood-vessels. Lymphatic tissue, which has been credited with this scavenging, appears to be much less important in this respect than was previously thought, for in spite of the absence of lymphatic tissue or vessels in the area between the two windows, and with no outlet except by way of the small blood vessels, a central mass of blood cells, fibrin and blood plasma clears up rapidly and the debris disappears. The space it occupied becomes filled with small blood vessels and connective tissue. Some of the mass may be taken up by macrophages but most of it is disposed of otherwise. Whether it is first digested by enzymes or in some other way is transformed so that it can be absorbed by the blood is not known, but observations through the windows showed that it can leave the tissues in the window-chamber only by way of the small blood vessels, there being no lymphatic vessels to carry it away. Drs. Clark and Williams observed in the same tissue that the nerves controlling the contraction of the muscle cells of the arterioles may undergo new growth and may re-establish their control over the contraction of the blood vessels. Dr. Clark said that this appeared to be the first study which correlates the surface regeneration of the sympathetic nerve with the functional activity of the part of the body it supplies.

Effect of Weed-Killers on the Soil. A question of importance in the use of chemicals for weed eradication is the possibility of such compounds exerting a deleterious effect on the soil, with risk of injury to the subsequent crop. Some investigations on these lines have been carried out by W. E. Bowser and J. D. Newton both in the field, greenhouse and under controlled conditions (*Canadian J. Research*, 8, 73). The liability of damage depends in part at least on the rate of decomposition of the chemical, its rate of movement in the soil and its effect on microbiological activity. Sulphuric acid and copper sulphate, which are employed chiefly as leaf sprays for the suppression of annual weeds, showed no lethal effect on the soil and nitrification was not affected. Sodium chlorate, on the other hand, which is mainly used for the eradication of perennials, remained undecomposed for a considerable time, poisonous effects being found nearly two years after application had been made. The rate of decomposition, however, was accelerated in the presence of much organic matter, and further, leaching removed the toxic compound from the surface layers of the soil, facts which suggest that a shallow rooted crop supplied with a good dressing of an organic manure would be advisable after a sodium chlorate treatment. Sodium bichromate decomposed rapidly, showing no residual toxic effects, but both this compound and sodium chlorate were alike in exerting a depressing influence on the numbers of soil micro-organisms.

The Genus *Diaporthe*, Nits. A very complete account of the ascomycetous fungi comprising the genus *Diaporthe* appears in vol. 17, part 4, of the *Transactions of the British Mycological Society* ("The British Species of the Genus *Diaporthe*, Nits and its Segregates" by L. E. Wehmeyer, pp. 237–295, March 1933). A brief key to the segregated genera is followed by very extensive keys to the British species of *Diaporthe* proper and of *Cryptodiaporthe*. Each species is afterwards described in great detail. The single species of *Apioporthe* and the two of *Diaporthopsis* receive full treatment. The publication of this account is all the more welcome since several species of the genus under review often attack the same host plant, causing great difficulty of determination in the absence of specialised knowledge.

An Electrical Calculating Machine. R. M. Mallock has described (*Proc. Roy. Soc.*, May) an electrical machine for finding the roots of a set of linear simultaneous equations. The machine consists of a number of transformers, one for each unknown and one for the numerical constants. Each transformer bears several windings. The number of turns in a winding may be varied by a dial switch, and the number of turns are made proportional to the coefficients in the equation. The windings are connected in series circuits corresponding to the equations. If now one of the transformers is excited, the fluxes in the cores adjust themselves to make the total voltage in each equation circuit zero, and the fluxes are then proportional to the roots of the equations. Errors are produced by magnetic leakage and by the resistance of the coils, and the latter are reduced by supplying magnetising current to each transformer from a valve amplifier and thus reducing the current necessary in the equation circuits. The machine which has been constructed will solve ten simultaneous equations with errors in the roots which may be less than 0·1 per cent of the largest root. If the number of unknowns is less than the number of equations, the machine may be used to obtain directly the 'least square' value of the roots, the weights of the equations being introduced as resistances in the equation circuits. The machine may save much labour in physical and engineering problems.

Absorption of Penetrating Radiation. Prof. E. Regener holds both the height record and the depth record for measurements of the ionisation due to penetrating radiation. In a recent paper (*Phys. Z.*, 8, 306; 1933) he describes both how he made measurements in Lake Constance down to a depth of 230 metres below the surface, and how he sent up an ionisation chamber attached to a free balloon to a height of 25 km., corresponding to an atmospheric pressure of 22 mm. of mercury. The design of the self-recording instruments is described in some detail. In order to avoid the disturbing effect on the sensitivity of the electroscope of the very low temperature of the atmosphere at such great height, use was made of the principle of the forcing-house. The ionisation chamber was completely surrounded by a light cage, the top half of which was covered with cellophane and the bottom half with aluminium foil. This proved very effective, for the temperature of the apparatus itself actually rose to 35° C. at a height of 20 km. The absorption curve obtained from these measurements in water and in the atmosphere is analysed into five homogeneous components of radiation, with absorption coefficients of $0{\cdot}205 \times 10^{-3}$, $0{\cdot}735 \times 10^{-3}$, $2{\cdot}0 \times 10^{-3}$, $4{\cdot}1 \times 10^{-3}$ and $8{\cdot}5 \times 10^{-3}$ cm.$^{-1}$ of water. The contribution of the first three components to the ionisation at the top of the atmosphere is estimated as 0·16, 1·2, 3·2, and of the last two together as 328 ion pairs per c.c. per second. On the assumption that these absorption coefficients refer to homogeneous electro-magnetic radiation, Prof. Regener estimates the wave-lengths of the two harder components to be $3{\cdot}28 \times 10^{-14}$ cm. and $13{\cdot}7 \times 10^{-14}$ cm., by assuming the validity of the Klein-Nishina formula when the nuclear electrons are also taken into account. These wave-lengths are in close agreement with those of light quanta having energies equivalent to the masses of α-particles and protons. The possible mechanism of annihilation processes which could give rise to such quanta is discussed. The softest of the five components is attributed, following Millikan, to the building-up of a helium nucleus out of protons and electrons. The total energy of the penetrating radiation which falls on the top of the earth's atmosphere is estimated as $3{\cdot}5 \times 10^{-3}$ ergs per sq. cm. per second; this is 30 per cent lower than the erroneous figure given in Prof. Regener's letter in NATURE of January 28, 1933, p. 130.

Lead from Cyrtolite. The mineral cyrtolite from Brunswick, New York, contains lead and uranium in the ratio 0·0513 and is nearly, if not quite, free from thorium. The atomic weight of the lead extracted from this cyrtolite has been determined by Baxter and Alter (*J. Amer. Chem. Soc.*, April). The lead was converted into chloride after exhaustive purification and the comparison with silver effected nephelometrically, the end point being approached from both sides. The estimated accuracy is 0·02 in the atomic weight of lead, which was found to be 205·924, that of common lead being 207·211 and that of lead from Swedish kolm, previously investigated by Baxter and Bliss, who found 206·013, being 206·007. Cyrtolite lead is essentially free from common lead, so that the lead-uranium ratio may confidently be employed in calculating the age of the mineral. The explanation of the low atomic weight is not obvious. Aston finds the lead isotopes integral with the mercury isotopes, which on the physical scale $O^{16} = 16{\cdot}0000$ had values 0·01 per cent higher than integral, the accuracy claimed being 0·01 per cent. If the conversion factor 1·00022 to the chemical scale $O = 16{\cdot}0000$ is used, the atomic weight of radium lead falls between 205·96 and 206·00. However, if the latter is always accompanied by actinium lead, Pb^{207}, in the proportions found in Katanga lead by Aston (NATURE, 129, 649, April 30, 1932) the average atomic weight of uranium lead should be 0·07 unit higher, a difference which Baxter and Alter say is far outside the apparent accuracy of their experiments. This suggests the possible presence in uranium lead of isotopes of mass below 206. Alternative explanations are that the atomic weight found by Baxter and Alter is too low or that the packing fraction of lead found by the mass-spectrograph is incorrect.

Astronomical Topics

The New Planet, 1933 HH. Further calculations have been made on the orbit of this planet by Dr. A. Kahrstedt of the Berlin Rechen-Institut. He uses photographic positions obtained at Johannesburg, extending from April 22 until May 17; but even this interval of 25 days proves to be insufficient to permit of an exact determination. He gives the two following orbits, both of which satisfy the observations within a few seconds of arc; the epoch for both is 1933 May 8.0, and the equinox 1933.0.

	First Orbit	Second Orbit
M	225·0638°	259·0403°
ω	130·3251	98·5149
Ω	340·0096	341·1686
i	7·2154	7·1040
φ	10·6735	8·1309
n	1859·510″	1550·297″
log a	0·187072	0·239728
Period	1·90813 y.	2·28871 y.

Both orbits indicate that the planet will be an easy telescopic object during the autumn. According to the first orbit it would approach the earth within some thirty million miles in December, and might be faintly visible to the naked eye; the second orbit would place it about twice as far away. In either case it would rank amongst the brightest of the minor planets, and its tardy discovery is somewhat of a mystery. It was badly placed at first for northern observers, but it is now observable as a morning star shortly before dawn. The following ephemeris is for 0^h.

	R.A.	N.Decl.	Mag.
June 17	$0^h\ 49^m\ 31^s$	5° 8′	9·3
25	1 5 7	7 13	
July 3	1 20 37	9 17	
11	1 36 1	11 20	
19	1 51 20	13 23	8·7

Eclipse of Hi and Ho. The story of these two ancient Chinese officials who were executed for some failure of duty in connexion with an eclipse of the sun is briefly mentioned in many books of descriptive astronomy. Dr. J. K. Fotheringham, in the April number of the *B.A.A. Journal*, gives the results of a careful study of all the documents that throw any light on the matter.

There was a great destruction of documents in China in 212 B.C. by order of the reigning Emperor; many of these were afterwards rewritten from memory, though no indication is given of the degree to which the restored texts can be trusted to be in agreement with the original. Dr. Fotheringham states that at the epoch referred to (about 2000 B.C.), it was not possible to predict eclipses, but the mean length of the lunation was known, and the calendar, which was a lunar one, was regulated accordingly. The fault of the officials was not the failure to predict an eclipse, but the fact that they allowed the calendar to get into confusion, so that an eclipse of the sun was observed on a day that was not the first of the month by their reckoning. This failure is stated in the narrative to have merited death, but their execution is not actually recorded.

Dr. Fotheringham does not think that it is possible to fix the exact date of the eclipse. He says that the one of 2155 B.C., which is selected by some writers, was not visible in China. The only clue is the statement that the eclipsed sun was in Fang. This is the name of an asterism in the head of Scorpio; but the word Fang is also used for "The order of the constellations", in which case it gives no assistance in finding the date.

The article also describes the musical and other ceremonials, including offerings of silk, that were customary at the times of eclipses.

The Royal Observatory, Greenwich

ANNUAL VISITATION

THE annual meeting of the Board of Visitors of the Royal Observatory was held on June 3. The Astronomer Royal, Dr. H. Spencer Jones, presented his report, noting that most of the work described in it had been carried out under the direction of his predecessor. The building and dome of the new 36-inch Yapp reflecting telescope have been completed; the telescope is being made by Sir Howard Grubb, Parsons and Co.; the spectrograph by Messrs. Adam Hilger, Ltd. Both have reached an advanced stage. Considerable progress has been made with the new transit circle which is being made by Messrs. Cooke, Troughton and Simms, Ltd.

Commander Gould has completed the restoration of Harrison's Time Machine No. 1, which is now in going order. He has also made a set of drawings of all parts, indicating those that replace original parts. He notes that Messrs. T. and F. Mercer generously supplied the balance springs and other new parts.

Meridian observations of the moon were made on 91 days. The mean correction to the longitude given by Brown's tables was +4·6″; it has been steadily diminishing since 1923, when it was +7·2″.

The second star catalogue for the epoch 1925 is in the hands of the printers; it contains all the stars, 10,600 in number, between north declination 32° and 64°, down to magnitude 8·0, also fundamental stars outside these limits. The proper motions of all the stars have been determined. The region from the equator to declination 24° is now being observed; this will be the last fundamental programme with the present transit circle. It is noted that, since its erection in 1851, about 600,000 star transits have been observed with it; also that, on the completion of the present catalogue, all the stars in the northern hemisphere down to magnitude 7·5 (and very many fainter ones) will have been observed at Greenwich since 1897. Vol. 6 of the Astrographic Catalogue was published during the year; it completes the determination of proper motions of stars in the zone between declination 64° and the pole; there are 252 stars that have proper motions exceeding 20″ per century.

The parallaxes of forty stars were published during the year, deduced from photographs taken with the Thompson equatorial; it brings the total number of parallaxes determined at Greenwich to 500.

The study of colour-temperatures of stars is being continued; a volume containing results for 63 stars was published during the year.

Good progress is being made with the measurement of plates taken for the determination of the parallax of Eros at the apparition of 1931. A new micrometer by Hilger, with a long screw, has been purchased.

Sunspot activity diminished further during the year; there were, however, two spot groups of considerable size; the largest one crossed the central meridian on Feb. 7. Observations of hydrogen flocculi with the spectrohelioscope were made daily when possible; the largest radial velocity measured was 110 km./sec. outwards on Oct. 6.

The usual magnetic observations were made at Abinger. The mean elements for 1932 were:—Decl. 12° 2·6′ W.; Hor. Force 0·18536; Vert. Force 0·42940; Dip 66° 39·1′.

The mean temperature for the year was 50·5°, being 1·0° above the average; the extremes were 98·9° on August 19 and 20·0° on Jan. 23. The rainfall was 24·77 inches, being 0·53 above the average.

Dr. J. Jackson resigned on March 1 his appointment as chief assistant, having been appointed His Majesty's Astronomer at the Cape. He had held his appointment since 1914, and has taken part in three expeditions to observe total eclipses of the sun.

A. C. D. C.

Falling Water-Level in the Chalk under London

A DISCUSSION on the "Falling Water-Level in the Chalk under London" was held by the Geological Society of London on May 19. In opening the discussion, Mr. Dewey said that London's subterranean water supply, derived from the Chalk, is maintained by rainfall. When artesian wells were first sunk, pressure was sufficient to raise water through the Tertiary beds to above sea-level. To-day, the water-table of the Chalk waters has sunk over wide areas to a depth of 200 ft. below Ordnance datum. This fall has been brought about by two possible main causes: first, the withdrawal of large quantities of water through numerous wells and boreholes sunk by water companies and others to the Chalk in the central area and in the Chalk along its outcrop south and north of the Tertiary beds; and secondly, the diversion of water, in drainage and other works, from the Chalk to sewage farms on the Tertiary beds and its consequent loss to the reservoir. A third, and only a minor source of loss, is the water pumped from the Chalk to supply districts lying on beds below the Chalk. As a result of these abstractions the water-table has fallen continuously for the last sixty years at least. In 1878, the water-table under the City lay at 100 ft. below Ordnance datum: to-day it is at about 210 ft., equal to a fall of 100 ft. in fifty-five years. The rate of fall is accelerative, and during recent years can scarcely have been less than 3 ft. annually. There appears, therefore, to be a grave prospect of the failure of some wells in the central area.

Schemes for the maintenance of the water-level have been suggested, but the risk of pollution has to be carefully considered before they are adopted.

Mr. J. Romanes said that the principal question is whether underground water supplies and underground storage are being used to the best possible advantage. Although no water engineer would think of constructing a surface reservoir until he was satisfied as to the intake, large sums of money have been expended in obtaining water from subsoil sources without any serious thought being given to the question of adequate replenishment. Nature, lavish in the provision of underground storage, is much less generous in replenishment, and the whole trend of the modern development of land drainage and similar services is to curtail still further natural replenishment.

The dangers Mr. Romanes foresees from a continuance of the present conditions are: a failure of the water supply from private wells, involving costly schemes to replace this supply from outside the London area; the spread of contamination in the basin due to the admission of polluted or brackish water; and subsidence due to the removal of an upward hydrostatic pressure on the base of the clay series of something like 3 tons per square foot, or a total upward pressure of more than 90,000,000 tons under the 'City square mile', together with the drying out of the Tertiary gravel beds.

The possibility of artificially aiding replenishment by the introduction of surplus water from the Thames and its tributaries is well worth serious investigation.

Dr. Herbert Lapworth's contribution showed that no general lowering of the water-level has been traced north of the line Bushey–Potters Bar–Hoddesdon, and it is not likely ever to occur north of this line in Hertfordshire. It appears from maps showing lines of equal lowering at 25-ft. intervals that the limiting line of 'no lowering' coincides with places where the underground water-level of the Chalk enters the Lower Tertiary gravel and sand bands between Bushey and Hoddesdon. This fact, which has never before been demonstrated, suggests that the Tertiary sands and gravels at the top of the Chalk are the main 'carriers' or 'replenishers' of London's underground water supply. These Tertiary beds between Bushey and Hoddesdon receive water from the Chalk at a certain rate dependent on the carrying capacity of the Chalk. They can convey water at a more rapid rate if the hydraulic gradient were steepened, but the supply is limited by the amount delivered from the Chalk. North of the Bushey–Hoddesdon line there has been no lowering of the water-level since 1878, and pumping to the south of the line only steepens the gradient of the water-table but does not draw faster into the reservoir.

Mr. E. Batchelor said that experiments by Mr. F. H. King on percolation through a black marsh soil indicate that percolation through the London Clay into the Thanet Sands below is not inappreciable. The percolation through the Chalk since it was raised above the sea has, by dissolving the Chalk, opened many fissures. One inch of percolation through the Chalk not covered by Eocene strata within the basin of the Thames above a point just down-stream of its confluence with the Lea would, if intercepted, yield 60,000,000 gallons of water a day.

The level of the water in a well is individual to that well, and varies with the yield and depth of each well. These levels should, therefore, be shown on a diagram by a series of dots and not by continuous contour-lines. The density of wells to each square mile is much greater in the City of London than elsewhere. The yield of the wells in 1913 was about 3,500,000 gallons a day. It would be greater if the wells were deepened, and still greater if more wells were sunk.

Prof. W. B. R. King commented on the complex nature of the problem. There are three main types of water-bearing rocks to be considered: (*a*) the Chalk where the joints and cracks had been opened by freely circulating rain-water; (*b*) the Chalk under the Tertiary beds and where the cracks had not been opened by circulating water; and (*c*) the Thanet Sands. It is difficult to decide in the London Basin exactly how the water travels to the centre of the area. In the north of France, however, the Thanet Sands are separated from the Chalk by an impermeable clay, and certain bores about six miles from the Chalk outcrop afford evidence that in that region more water travels in the sands than in the cracks and joints of the Chalk.

Association of Teachers in Technical Institutions

THE twenty-fourth annual conference of the Association of Teachers in Technical Institutions was held at Lincoln during the Whitsuntide vacation. A civic welcome was accorded to the Association by the Right Worshipful the Mayor of Lincoln, who was accompanied by the chairman of the Education Committee (Councillor Mrs. Lane) and the Very Rev. the Dean of Lincoln. The president for 1933–34, Mr. F. H. Reid, was inducted by the retiring president, Mr. S. H. Moorfield.

In his presidential address, Mr. Reid covered a wide field. If technical education is to play its part, he said, technical teachers must realise still more that their work touches all points of the social, educational and industrial fields. They have to deal with problems of unemployment for which science and technology will be increasingly responsible, with the problem of equalising the efficiency of distribution and production, with the problems raised by continental countries which are using technical education as a weapon in international competition, with the whole vast problem of preparing students to take their place in a world changing with marvellous rapidity.

Admitting that many of these points were familiar to the audience he was addressing, Mr. Reid insisted that their implications and significance are not yet generally grasped. How else could a London evening newspaper make the following comment: "The machine is enslaving us. The technical sciences are its janissaries. Liberal education is the last stronghold of the free. Beleaguered and starved, its overthrow is only a matter of time." The news which prompted that comment, remarked Mr. Reid, came from the Continent by telegraph or telephone. It was doubtless sent to the room where the article was written by similarly swift and sure methods. The room was almost certainly lit by electric light. The writer was clothed in garments made by modern scientific processes. Just as marvellous processes transformed his thoughts into the printed word. Complex transport arrangements brought the newspaper to its readers in the space of minutes, while the writer doubtless went home by tube, and, warmed and comforted by smokeless fires, gave himself up to the enjoyment of music broadcast by means of the latest "technical sciences". Yet he is enslaved by the machine! How long will it be, asked Mr. Reid, before there is a general realisation that the ordered, efficient State towards which all technical sciences work is the only structure in which beauty and freedom can ultimately really be known?

Among the resolutions adopted by the Conference was one urging that extension of technical education with a minimum of duplication of effort, can be effected only by some system of consultation and co-operative planning within larger administrative areas than are in existence at present. It was insisted, however, that in arranging such regional co-ordination, teachers should be brought into consultation. Another resolution urged that apprenticeship conditions (or their equivalent) should be restated for the various industries and that the whole question of conditions of entry into industry and of the provision of opportunity for young entrants to qualify for skilled operative and higher posts should be immediately considered.

Food of Icelandic Herrings*

DR. P. JESPERSEN has made an important contribution to the biology of the herring in his investigations on its food in Icelandic waters. A large number of adult fishes have been examined, mostly collected during the great herring fishery of Iceland from June until September. The nets used were the purse-seine, fishing chiefly in the surface layers near the coast, and the drift-net, fishing in the deeper water of the open sea.

The food was found to be very different in the herrings from the two nets even if they were caught in the same water, those from the seine net having far more food in them—not one being found without food—while those from the drift-net were often empty, especially in autumn. This is presumably explained by the fact that the surface waters fished by the purse-seine nets have far more food in them in the summer than the deeper waters fished by the drift nets. The stomachs with the most food correspond with the largest catches of herrings, when there is the greatest amount of plankton. The herrings only come to these northern waters to feed at this time of year as they spawn in the warmer waters of the south and west.

The stomachs were taken from the freshly caught fishes, those from each catch (10–20) being placed in a separate bag and preserved in formalin. Later, the volume of each stomach contents was noted and the food roughly analysed both quantitatively and qualitatively. The percentage of herrings from each net feeding on certain food was then estimated.

As was to be expected, copepods form the largest part of the herring food. Nearly all the purse-seine fishes were feeding on them, euphausiids coming next in importance, amphipods, crab larvæ and pteropods also being eaten. The drift-net fishes fed largely on copepods at times and they also ate the other food mentioned above. Besides these there were present in smaller quantities in the fishes from both nets decapod and cirripede larvæ, cladocerans, gastropods, polychætes, chætognaths, fishes and fish eggs. Sometimes crab larvæ (almost entirely *Hyas coarctatus*, both zoeæ and megalopæ, which occurred in swarms at certain seasons) and *Ammodytes* were eaten in numbers.

Of the copepods, *Calanus finmarchicus* is much the most important food. It is found in huge masses in the waters north of Iceland, colouring the sea red, and it constitutes at least 95 per cent of the copepods eaten. Others taken by the herrings are *Temora longicornis* (very occasionally predominating), *Calanus hyperboreus*, *Metridia longa*, *Pseudocalanus elongatus*, *Microcalanus pygmæus*, *Acartia longiremis* and *Oithona similis*. Euphausiids (*Meganyctiphanes norvegica*, *Thysanoessa* (=*Rhoda*) *inermis*, *Thysanoessa* (=*Rhoda*) *raschii* and *Thysanoessa Longicaudata*) are eaten by the fishes from both nets, the adults chiefly by the drift-net herrings, the younger stages, which inhabit the surface layers, by the seine-net herrings. The pteropods *Limacina retroversa* and *Limacina helicina* occur sometimes very commonly in these seas and occasionally fill the stomachs of the drift-net herrings, especially in August and September.

University and Educational Intelligence

CAMBRIDGE.—The Botany School has received from the estate of Mr. S. H. Bickham a valuable collection of several thousand specimens of plants and eighty-five botanical books. The bequest is a very important addition to the herbarium, since nearly all the specimens are of British plants and the herbarium has specialised in British and colonial species.

Prof. D. B. Copland, of the University of Melbourne, has been appointed Alfred Marshall lecturer for 1933–34.

A University lecturer and a University demonstrator in the Department of Anatomy will be appointed shortly; applications should be made to Prof. J. T. Wilson, Anatomy School, Cambridge, by July 10.

The electors to the Wyse studentship in social anthropology announce that they have awarded studentship of £250 for one year to Miss M. M. Hunter, Port Elizabeth Collegiate School and Girton College.

LONDON.—The following City companies have made grants to the University, payment in each case being spread over a period of years:—The Merchant Taylors' Company, £5,000; the Stationers' Company, £100. These benefactions will be applied towards meeting the cost of the new ceremonial hall to be erected on the University's site in Bloomsbury. A grant of £100 has also been made by the Guardian Assurance Company towards the cost of the new buildings.

OXFORD.—The Committee of Management of the Lewis Evans Collection of Scientific Instruments has published its annual report. Many accessions are enumerated, including gifts to the library and to the collection of portraits. The need is pointed out of an endowment for a curator.

SHEFFIELD.—The following appointments have recently been made:—Dr. L. C. D. Hermitte, demonstrator in pathology, the post to be held in conjunction with that of assistant pathologist to the Royal Infirmary; Dr. Eric James, junior assistant bacteriologist and demonstrator.

Prof. E. Mellanby has resigned from the chair of pharmacology, and Mr. J. W. Kershaw from the senior lectureship in mechanical engineering.

THE Association of Technical Institutions will hold its summer meeting at the Municipal College of Science, Manchester, on June 29–July 1, under the presidency of Sir Hugo Hirst, chairman of the General Electric Co., Ltd. The following papers will be read and discussed at the meeting: "The Training of the Technical Teacher" by J. H. Currie; "The Textile Industry" by Prof. W. E. Morton; and "Management Education, the Case System", by Principal G. A. Robinson. Further information can be obtained from Dr. H. Schofield, Loughborough College, Loughborough.

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* P. Jespersen, "On the Food of the Herring in Icelandic Waters". Meddelelser fra Kommissionen for Danmarks Fiskeri og Havundersegelser. Serie Plankton. Bind II. No. 3. 1932.

A Busk studentship in aeronautics, established in memory of Mr. E. T. Busk, will be awarded during July. The studentship is valued at £150 for one year, but may be extended to two years. The student will be expected to carry out research in aeronautics, especially in stability problems, meteorological questions bearing on flight, or the investigation of gusts. The investigations may be carried out either at home or abroad. Further information can be obtained from Prof. B. Melvill Jones, Engineering Laboratory, Cambridge.

A RECENT (November, 1932) number of "University of Colorado Studies" is devoted to the publication of a collection of abstracts of theses for higher degrees, an enterprise which few university administrations consider to be worth its expense. Here we have a hundred and seventy abstracts, on an average 350 words each, constituting a cross-section of the course of advanced study and research in progress in the University. More than one-fifth of the theses are records of research in pedagogy. Of the remainder, half deal with humanistic and half with scientific topics. Theses on engineering subjects number 17 (electrical engineering 13), biological 14, chemical 10, physical and geological 6 each. A fairly large number of them are records of regional surveys.

THE *Universities Review* has in its April issue several articles of unusual interest. Prof. S. Brodetsky describes the plight of Jewish university teachers in Germany and the prominent place taken by Jews in intellectual life in that country. He explains the growth of the pseudo-scientific anti-Semitism which found such a successful exponent in Houston Stewart Chamberlain, whose work "The Foundations of the Nineteenth Century" formulated German racial pride and its application to Jews in a way that won the approval of the Kaiser and his advisers and added venom to an already virulent complex, aggravated and sharpened since the War by the rapid growth of an academic proletariat in excess of the capacity of the country to absorb them in useful occupations. The work of its International Relations Committee forms the subject of the presidential address to the Association of University Teachers which is reproduced in this number, and there is a report on continental students in British universities. Academic freedom in the United States is discussed by Preston Slosson who corrects the distorted picture drawn by Upton Sinclair in his "Goose Step" by showing that plutocracy is only one of a host of dangers by which freedom is beset. An informative article by F. A. Went and R. C. McLean on the Dutch university system is a useful addition to the series of similar papers which the *Review* is publishing. Eugen Rosenstock writes about the "mortal disease" of specialisation and urges by way of remedy the grouping of opposites into a sort of common life as in settlements, summer schools and camps.

Calendar of Nature Topics

Shamal

The prevailing wind in the Persian Gulf and the Sea of Oman blows from the north-west and is called by the Arabs 'shamal'. A shamal may occur in any month of the year, but it blows almost without cessation during June and the early part of July, when it is known as the 'great' or 'forty-day shamal'. A shamal may set in suddenly at any hour of the day or night, and generally lasts from one to five days. Although the wind is not usually strong, rarely exceeding thirty miles an hour, it is very hot and dry, and carries great quantities of dust from the deserts of Persia and Mesopotamia. The sky is cloudless, but the haze is often so thick as to obscure the land, making navigation dangerous, and the decks of ships far out at sea are covered by a fine impalpable dust.

Frequency of Birds

The number of birds in an area fluctuates considerably throughout the year, under the influence of changing quantities of food, whether vegetable or animal, of birth rate and death rate, and of migration. But in inland parts of the northern hemisphere the numbers reach their climax in June, a fact to be correlated with the height of the nesting season in the latter half of May (see "Nature Calendar", March 25, p. 445). In June the newly-fledged broods of the year still keep together in their home area, but as the year progresses their ranks are thinned by death and the relicts scatter over a wider territory.

An interesting confirmation of the June climax in bird numbers comes from Yosemite Valley in the Yosemite National Park, California. There, since the summer of 1920, Mr. and Mrs. Charles W. Michael have kept daily records of all species of birds seen by them. At the end of each month a summarised report of all observations for the preceding thirty days has been sent to the Museum of Vertebrate Zoology, Berkeley, California; and now Dr. Jean M. Linsdale has used the daily records for the period August 1, 1920--November 30, 1931, to estimate the relative frequency of occurrence of the birds in the Valley (*Condor*, **34**, 221; 1932.) The species seen numbered 151, but of these only 40 were observed on more than 20 per cent of the days. A rough test of the relative numbers of birds present will be given by comparing the monthly numbers of species seen every day during the month. Extracting from Dr. Linsdale's statistics, we find that these numbers form a simple unimodal curve, at its lowest in January and December with 1 and 0 species seen every day, and rising to an apex in mid-summer with 13, 20, 12 in May, June and July respectively. This indication that June is the month of highest bird population in Yosemite Valley is confirmed by analysis of the monthly totals of observations of the forty most common birds.

Breeding Season of Sea-Lions in California

From the middle of June to the middle of July the breeding season of the sea-lions of California is at its height. Then the breeding adults, grouped in harems of females dominated by a master bull, form rookeries upon the islands off the coast, and when the single pups are born the sea-lion population is at its maximum. It was at this period that, in

1930, a census of the sea-lions was made (Paul Bonnot in *California Fish and Game*, 1931, p. 150). Two species were involved, the California sea-lion (*Zalophus californianus*), the smaller of the two, weighing about 500 pounds, and Steller sea-lion (*Eumetopias jubata*) the male of which weighs between 1,500 and 1,800 pounds. The census revealed that, as a rule, one species avoids the rookeries of the other. Of seventeen island rookeries, the two species occurred together on six only, and generally one was dominant and the other represented by a relatively small number of individuals. The California sea-lion is a southern species, less numerous in California, with 968 individuals, than the Stellers with 6,360, and the latter becomes predominant northwards, where it ranges to the Bering Straits. Counts of individuals made in 1927, 1928 and 1930 show that while the Stellers are increasing in numbers the Californias are decreasing. Since both species are subject to the destruction caused by professional hunters and collectors, the difference seems to be due to the limited range of the Californias, which have been harried to such an extent that several of the larger rookeries have been materially reduced or abandoned, whereas in spite of local destruction the rookeries of the Stellers are replenished by an influx of new individuals from the north, where, under a bounty system, the species is even more intensively hunted.

Early Potatoes

Farmers in England are now about to realise the first cash crop of the season. In a few favoured districts first early potatoes will be ready to lift. Their production is a highly specialised business, the controlling factor being a rare combination of soil and climatic conditions: a warm, free-draining soil sheltered from the north and east, with comparative freedom from frost and drought in May. With these natural advantages growers provide every artificial aid in forcing on the crop. Heavy dressings of bulky organic manures are given and these are further reinforced by generous additions of chemical fertilisers. In the famous 'early districts' the potato crop is taken much more frequently than is normally the case; nevertheless, little faith is placed in manurial residues and each crop is treated with the same generosity. The fact is that the period of high prices at the opening of the season is a very restricted one and no economy is considered worth while which might cause the crop to miss the first demand. Crops are always lifted immature, indeed a further fortnight's growth would almost double their yield but might actually reduce the acre value. Only the earliest home-produced crops come in in June, the Cornish supplies being the first; most of the supplies arrive in July and with them the price gradually comes down to a level not very different from that of the main crops which follow.

Cropping the same land at frequent intervals, the early growers do not escape the troubles almost invariably associated with the localisation of any crop. Of these, the eelworm disease is one of the most serious and is now a grave pest in many districts except perhaps on the very earliest crops. In one respect, disease has affected the industry in a favourable direction. The exclusion of foreign early potatoes likely to be affected with Colorado beetle has to that extent enlarged the market for home-produced supplies.

Societies and Academies

LONDON

Geological Society, April 26. L. S. B. LEAKEY: Fossiliferous deposits in the Homa-Kendu Area, Kenya Colony. The best exposures were found at Kanjera, the site previously discovered by Dr. Oswald, and at Kanam, some three miles farther to the west. The deposits, which must have been laid down in a former very great extension of Victoria Nyanza, were considerably affected by faulting and had a dip varying from 20° to 90°. At Kanjera fragmentary skull-caps of three individuals, as well as a fragment of a human femur, were recovered, and at Kanam a small fragment of a human mandible. These remains are remarkable because they represent very early human beings, who, in spite of their primitive characters, seem to approach *Homo sapiens* more closely than any other fossil humans of comparable age. The Kanam deposits and, therefore, the Kanam mandible are regarded as Lower Pleistocene, whilst the Kanjera deposits and the Kanjera skulls are to be attributed to the Middle Pleistocene.

DUBLIN

Royal Irish Academy, March 16. J. G. SEMPLE: Composite surfaces in higher space. The relations, obtained by Severi, which connect the projective characters of two algebraic surfaces in r dimensional space ($r \geqslant 4$) when they together form the complete intersections of $r-2$ primals of specified orders, are extended in this paper to cover the case when the primals intersect in any number of surfaces. The equations so obtained can then be re-arranged to show that definite virtual projective characters can be assigned to a general composite surface consisting of any number of irreducible surfaces intersecting in specified curves. The virtual unreduced canonical system of a composite surface is also defined, and examples are given of the manner in which the unreduced canonical system of an irrational surface breaks up when the surface degenerates into a composite surface. The bearing of the results obtained on the problem of the limiting envelope of a degenerate surface is also considered.

PARIS

Academy of Sciences, May 1 (*C.R.*, **196**, 1253–1344). JULES DRACH: A class of congruences of right lines. C. MATIGNON and J. CALVET: Ageing of the aluminium-beryllium alloys after tempering. The aluminium-beryllium alloys studied, prepared from highly purified materials, after tempering, underwent a very rapid ageing at the ordinary temperature; fifty per cent of the transformation took place in ten minutes. P. A. DANGEARD: Remarks on the presence of a centrosomic apparatus in species of the genus *Lonicera*. The results recently published by Feng have been criticised: the author confirms the accuracy of the observations. J. COSTANTIN: Is the immunity of the sugar-cane *POJ* 2878 absolute? R. FOSSE, P. DE GRAEVE and P. E. THOMAS: The rôle of allantoic acid in the higher plants. E. J. GUMBEL: The representations of unimodal distributions unilaterally limited. P. DUBREIL: Some properties of the characteristic function of Hilbert. P. VINCENSINI: Stratifiable congruences. V. LALAN: Affine developants of minimal curves. B. GAMBIER:

A congruence of circles osculating the lines of curvature u = const. of a surface S_1 and v = const. of a surface S_2. **DELSARTE** and **RACINE**: A special binary ds^2. **CHR. FOUSIANIS**: A theorem of E. Borel. G. D. **MATTIOLI**: The theory of turbulence in channels. **FLORIN VASILESCO**: Movements in three dimensions, with a wake. **HENRI CHRÉTIEN**: An impersonal astrolabe. A. **PÉRARD** and M. **ROMANOWSKI**: First comparisons of the national standards of electrical resistance, carried out at the Bureau international des Poids et Mesures. The standards compared were from Berlin, London, Paris, and Tokyo: the Washington (Bureau of Standards) standards were not available. Differences of 0·1 microhm could be detected. The difference between the French and Japanese ohm is nearly a ten-thousandth. **PAUL JANET**: Remarks on the preceding paper. N. **STOYKO** and R. **JOUAST**: The apparent velocity of short radio-electric waves. The apparent velocity of radio-electric waves is always less than the velocity of light owing to differences of path. For short waves (15–40 m.) between Paris and Buenos Aires, the apparent velocity was 269,700 km./sec., a value agreeing with that previously found by the indirect method. For long waves, the velocity found was 245,000 km./sec. The differences can be explained by the difference in the mechanism of propagation of the two varieties of waves. TH. V. **IONESCU** and MME. **IRÈNE MIHUL**: High-frequency discharge in gases. Studies on the effect of a magnetic field on the maintenance of the discharge. A magnetic field reduces the potential necessary for the maintenance of the discharge in a tube. H. **HULUBEI** and MLLE. Y. **CAUCHOIS**: Weak lines in the K spectra of the elements 45, rhodium, and 42, molybdenum. Confirmation of some earlier results and description of some new lines. C. **HAENNY**: The magnetic double refraction of some cerium salts in aqueous and non-aqueous solutions. The magnetic double refraction of a saline solution is markedly affected by the presence of an excess of the acid forming the salt. For cerium, the magnetic double refraction and the paramagnetism is essentially due to the presence of the electron detached from the cerous ion. **JACQUES WINTER**: The diffusion of electrons by atoms. **CHARLES LAPICQUE**: The non-additive effect of different radiations on copper oxide cells. R. **DEAGLIO**: The photoelectric effect in the monocrystals of cuprite. The experimental results described prove that the photoelectric effect discovered by Dember is simply a consequence of the property of cuprite of acquiring an electrolytic conductivity when it is illuminated. R. **COUSTAL**: A connexion between the two general methods for the preparation of phosphorescent zinc sulphide. The author has fused zinc sulphide in nitrogen under a pressure of 160 km. at a temperature of 2000° C. and has obtained a phosphorescent sulphide with an optimum concentration of the copper phosphorogene of about 10^{-6}. —. **POIDEBARD**: A new method of taking aerial photographs in tropical climates. The photographs are taken at a low altitude and facing the sun. MME. **BRANCA EDMÉE MARQUES**: The distribution of the radium in the fractional precipitation of radiferous barium chloride. An experimental study of the precipitation of mixed barium and radium chlorides by hydrochloric acid. P. **LOCUTY** and P. **LAFFITTE**: The system ammonium sulphate, sulphuric acid, water. MLLE. M. **PERNOT**: The system mercuric bromide, potassium bromide, ethyl alcohol. **JEAN BOUCHARD**. The quantitative study of the inhibiting action of some organic compounds on the fluorescent power of uranine. MME. L. S. **MATHIEU-LÉVY**: The catalytic oxidation of carbon monoxide. The evolution of the catalyst. **RENÉ PERRIN** and **ALBERT PORTEVIN**: The evolution of the inclusions in the elaboration of steels. B. **BOGITCH**: The use of hot air in the fusion of minerals with a water jacket. P. CH. **DORIER**: The action of 1·3 dichloropropene on the sodium derivatives of the aryl fatty acids. **CHARLES DUFRAISSE** and J. A. **MONIER, JR.**: Researches on the dissociable organic oxides. *Bis*–1.1′.(*p*–tolyl)–3.3′.diphenyl–5.5′–dimethyl–rubene: its dissociable oxide. The introduction of the two methyl groups has not affected the property of the rubenes of fixing free oxygen reversibly. **MAURICE LOURY**: Researches on the acetylene carbinols: phenylcarbethoxyphenylethinyl carbinol, $C_{18}H_{16}O_3$. MME. F. **BAYARD-DUCLAUX**: Study of methods for putting in circuit specimens of rock for measuring their electrical resistance. The specimen is held by two stirrups, one of which is fixed and the other loaded to known amounts. The pressure is constant and the insulation sufficient. For rocks permitting the production of an optically polished surface good contact can be obtained with electrodes of silver foil under low pressure. For other rocks a higher pressure is required and the minimum pressure must be determined for each specimen. **PHILIPPE HAGENE**: Characters of the humus of pollarded willows. EM. **SAILLARD** and R. **SAUNIER**: The determination of the ash of sugar beet juice by measurement of the electrical conductivity. MME. **NELICIA MAYER-REICH**: The action of oxygen on glucides developed in the absence of air. P. **NÖEL BERNARD** and J. **GUILLERM**: The transmissible lysis of the cholera vibrion. It is possible to extract from pure cultures of the cholera vibrion, by the usual methods for the extraction of diastases, a lytic substance. This is specific, has an optimum pH of action, and reproduces exactly the phenomenon of bacteriophagy. MLLE. A. **MICHAUX**: The amounts of total phosphorus in the blood and muscles and the elimination of this element by the renal canal in the course of acute scurvy and chronic scurvy.

CRACOW

Polish Academy of Science and Letters, Feb. 6. S. **BANACH**: Green's formula. LAD. **NATANSON**: Permanent fields of radiation. W. **SWIETOSLAWSKI** and E. **WARDZINSKI**: The ternary heteroazeotrope: ethyl alcohol, water, carbon disulphide. A description of a modified differential ebullioscope with fractionating column, and its application to the above mixture. W. **JACEK**: The velocity of solution of marble in acids (3). Study of the rate of solution of marble in hydrobromic acid as a function of the concentration. L. **MARCHLEWSKI** and J. **DABROWSKI**: Studies in tautomerism, carried out by means of the spectrophotometric method. The results of Hartley and Dobbie on the constitution of isatin are confirmed. K. **DZIEWOŃSKI** and J. **MAYER**: A new method of synthesis of compounds derived from quinoline. CZ. **KUZNIAR**: Rock salt from Morszyn. J. **TUR**: The correlation between the formation of the vitelline vessels and that of blood corpuscles. B. **SKARZYŃSKI**: Studies on the transformation of carotene into vitamin A in animals.

GENEVA

Society of Physics and Natural History, March 2. M. **GYSIN**: Petrographical researches in the Haut-

Katanga. Note 3. The formations of the Roan series. (1) The author shows the great lateral variations of facies and thickness which the formations of the Roan series undergo in the south-eastern part of the Haut-Katanga. He gives a mean stratigraphic scale subdividing the Roan series into six horizons. The rocks which form these six horizons may be classed in sixteen distinct petrographical types. G. TIERCY: The mean absorption coefficient in a variable star of the Cepheid type. The author studies the relation which exists between the ratio of the total flux corresponding to two phases of the variation, the ratio of the respective mean absorption coefficients, and the ratio of the corresponding pressures of the reversing layer. G. TIERCY and A. GROSREY: Study of the width of a photographic stellar spectrum for stars of the type *A*5. The authors establish for stars of this type a formula giving the variation of the width of the spectrum as a function of the time of exposure and the magnitude, the stellar image being supposed to be kept on the cross wires of the finder during the whole of the exposure. ROSSIER: The diameter of some stars of the cluster *M*.7. The author compares the results obtained by M. Wallenquist with those given by his formula. The results are somewhat uncertain on account of the want of knowledge concerning the sensibility curve of the receivers used.

VIENNA

Academy of Sciences, Feb. 9. EDMUND FRAENKEL and JULIUS ZELLNER: Contributions to comparative plant chemistry. (24) *Heracleum spondylium*, L. The roots of this plant contain two substances of the ostruthin type (to be investigated), considerable proportions of resin, a sterol, a wax-like material, a choline-like base, glucose, and starch. JOSEF KLIMA: Chemistry of the lichens (2). *Alectoria ochroleuca*, Ehrh. In addition to the two known lichen acids, this lichen contains an amorphous lichen substance of non-acid character, a solid hydrocarbon, a sterol, oleic and linolic acids, small amounts of solid fatty acids, a crystallisable sugar-alcohol (probably erythritol), glucose, basic substances of choline type, and lichenin in abundance. LEOPOLD LUKACS and JULIUS ZELLNER: Chemistry of the higher fungi (22). *Ganoderma lucidum*, Leiss, *Hydnum imbricatum*, L., and *Cantharellus clavatus*, Pers. The *Ganoderma* species contain a specific resin and large proportions of a brown colouring matter, which is insoluble in all indifferent solvents and soluble only in alkali hydroxide and resembles certain humic acids; in addition, ergosterol, mannitol, fatty acids, polysaccharides and other substances commonly found in fungi, are present. The two other species yielded no specific ingredients, other than colouring matters of amorphous consistency and low stability. WOLF J. MÜLLER: Theory of passivity phenomena (18). Fluctuation phenomena in anodic passivification. Results are cited which indicate that the thickness of the layer varies during anodic passivification. Hence the covering laws are valid only within certain statistical limits of fluctuation, and passivity phenomena must be investigated statistically, a large number of experiments being made for each separate case. HERMANN VEIT GRABER: New observations in the region of the crystalline shales and massive rocks of Eisenkappel in southern Carinthia.

Forthcoming Events

Monday, June 19

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Annual General Meeting.

BRITISH SCIENCE GUILD, at 4.30—(at the Mansion House, London, E.C.4).—Annual General Meeting. At 5. Prof. R. S. Troup: "Some Problems of British Forestry".

Thursday, June 22

RESEARCH DEFENCE SOCIETY, at 3—(at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1).—Annual General Meeting. Maj.-Gen. Sir Leonard Rogers: "The Saving in Life and Suffering, due to Medical and Veterinary Research, with special Reference to the Tropics (Seventh Steven Paget Memorial Lecture).

ROYAL SOCIETY, at 4.30.—Discussion on "The Ionosphere", to be opened by Prof. E. V. Appleton.

Official Publications Received

GREAT BRITAIN AND IRELAND

The Empire Forestry Handbook, 1933. Edited by W. A. Robertson. Pp. 167. (London: Empire Forestry Association.) 5s.; free to Members.

Y.H.A. Handbook to Hostels, 1933. Pp. 72. (Welwyn Garden City: Youth Hostels Association.) 6*d*.

Proceedings of the Society for Psychical Research. Part 130, Vol. 41, May. Pp. 139–253. (London: Society for Psychical Research.) 3*s*.

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 6 (New Series), No. 4, April, Abstracts Nos. 578–769. Pp. 109–144. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

The Institute of Physics. Report of the Board for the Year 1932. Pp. 13. (London: Institute of Physics.)

The Royal Society for the Protection of Birds. Forty-second Annual Report, January 1st to December 31st, 1932; with Proceedings of Annual Meeting, 1933. Pp. 60. (London.)

The Lister Institute of Preventive Medicine. Report of the Governing Body, 1933. Pp. 34. (London: Lister Institute.)

The Quarterly Journal of the Geological Society of London. Vol. 89, Part 2, No. 354, May 25. Pp. 85–201+lxxxvi+plates 7–18. (London: Longmans, Green and Co., Ltd.) 7*s*. 6*d*.

Board of Education. Report of the Advisory Council of the Science Museum for the Year 1932. Pp. 37. (London: H.M. Stationery Office.) 9*d*. net.

Twenty One Years: a Review of the Progress and Achievements of the BEAMA. Pp. viii+60. (London: British Electrical and Allied Manufacturers' Association.)

Standing Commission of Museums and Galleries. First Report. Pp. 28. (London: H.M. Stationery Office.) 6*d*. net.

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation, submitted at the Twelfth Annual General Meeting on May 26th, 1933. Pp. ii+74. (London.)

OTHER COUNTRIES

Science Reports of the Tokyo Bunrika Daigaku, Section A. No 24: Some Remarks on Montel's Paper concerning Upper Limit of Absolute Values of Roots of Algebraic Equations. By Tikara Tôya. Pp. 275–282. 15 sen. No. 25: Remarks on some Coefficients of a Schlicht Function. By Shigeo Ozaki. Pp. 283–287. 15 sen. (Tokyo: Maruzen Co., Ltd.)

Journal of the Indian Chemical Society, Special Number. Sir Prafulla Chandra Rây: Seventieth Birthday Commemoration Volume. Pp. vi+363. (Calcutta: Indian Chemical Society.)

Journal of the Faculty of Science, Hokkaido Imperial University. Series 4: Geology and Mineralogy. Vol. 2, No. 1, November 1932. Pp. 131+20 plates. (Sapporo.)

Transactions and Proceedings of the Royal Society of South Australia. Vol. 56. Edited by Prof. Walter Howchin. Pp. iii+226+9 plates. (Adelaide.) 15*s*.

Journal of Science of the Hiroshima University. Series B, Div. 1 (Zoology), Vol. 2, Articles 4–7, March. Pp. 49–127+9 plates. (Tokyo: Maruzen Co., Ltd.) 95 sen.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 422–425: On the Chemical Constituents of Rice-embryo, by Riang-Ha Kimm and the late Taro Noguchi; On the Phosphorescence in Human Tissues, Part 2: On the Phosphorescence of Human Concrements and Pathological Calcific Tissues, and the Effect of Calcination Temperature upon the Phosphorescence of Calcined Tissues, by Shirobee Hoshijima; Diffraction of Cathode Rays by Mica, by Ken'ichi Shinohara and the late Kyûzi Matukawa; Influence of a Magnetic Field on Anode Spot, by Toshio Takamine, Taro Suga and Asao Yanagihara. Pp. 33+4 plates. (Tokyo: Iwanami Shoten.) 50 sen.

Memoirs of the Indian Museum. Vol. 12, No. 2: Classification, Bionomics and Evolution of Homalopterid Fishes. By Sunder Lal Hora. Pp. 263–330. (Calcutta.)

Proceedings of the Royal Society of Victoria. Vol. 45 (New Series), Part 1, 28th February. Pp. iv+31+7 plates. (Melbourne.)

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The World Economic Conference

THE World Economic and Monetary Conference now meeting in London is undoubtedly the most comprehensive and authoritative congress of its kind which has ever been convened. Sixty-six governments, ten of which are not members of the League of Nations, have sent representatives. Never before has there been such a meeting of heads of governments, ministers of foreign affairs and ministers of finance, with their technical advisers and experts.

The Conference is the sequel to the work done last year at Lausanne, when an immediate financial collapse was averted by means of a temporary agreement on War debts. The Council of the League of Nations then agreed to the recommendation of the Lausanne Conference that it should convene a wider conference to tackle the whole problem of the world crisis. A Preparatory Commission of experts was appointed to report on an agenda for the business of the World Economic Conference and the report of this Commission has been made the basis of the deliberations of the present Conference.

The magnitude and difficulty of the problems discussed in this report and now confronting the Conference are only matched by the urgency of the crisis and the desperate need of the world for harmonious international action designed to secure the alleviation of its economic malaise. The number of workers now without employment has been estimated by the International Labour Office to be at least thirty millions, but even this figure gives but a very inadequate conception of the universal distress, as it takes no account of dependants or of the distress afflicting the agricultural populations of the world.

Since October, 1929, the level of wholesale prices has fallen by about one-third, thus seriously reducing the purchasing power of countries engaged in primary production and imposing a serious check to trade in practically all countries. World stocks of agricultural products and other raw materials continue to accumulate without prospect of a sale for the surplus ; industrial production has been drastically curtailed and has declined by something like a third ; national incomes have fallen seriously, in some cases by so much as 40–50 per cent. The total world trade in the third quarter of 1932 was only about one half the volume of that in the corresponding quarter of 1929, while its value was only about one-third. Only about a dozen countries have retained free and uncontrolled gold currencies, with the result that fluctuating exchanges and competition between nations in currency depreciation have further served seriously to disorganise international trade, which has also been nearly strangled by high tariffs, exchange restrictions, quotas and even prohibitions, not to mention disturbances in the normal channels of trade imposed by subsidies or other methods designed to promote national economic policies. As Mr. MacDonald stated in his opening address, "no one who has surveyed the facts and watched their progress can doubt for a moment that the experiences of the last few years have proved that a purely national economic policy in this modern world is one which by impoverishing other nations impoverishes those who pursue it".

The programme of reconstruction suggested by the Preparatory Commission did not include the problem of inter-governmental debts, because this lay outside its terms of reference, but it stated that, "until there is such a settlement, or the definite prospect of such a settlement, these debts will remain an insuperable barrier to economic and financial reconstruction". During the first week of the Conference, the general conviction unquestionably appeared to be that any solutions proposed by the Conference, if they are to be effective, must be accompanied by the settlement of War debts. Mr. MacDonald, Signor Jung, General Smuts and others have been emphatic on this question. Though it lies outside the scope of the Conference, this question of debt settlement is nevertheless inseparably linked with its work of world reconstruction. The first step towards its final settlement has now fortunately been provided by the statesman-like action of President Roosevelt, who in the face of all his domestic difficulties, accepted the British Government's proposal of a payment of ten million dollars in silver in recognition of British liability, pending a final adjustment of the matter. The merit of this arrangement is that it is neither default, which would be disastrous, nor payment in full, which would have left the old problem with us and might have jeopardised the success of the Conference.

In the field of monetary and credit policy, the Preparatory Commission recommended that the objective should be the restoration of an effective international monetary standard, together with a policy of easy money designed to promote a healthy expansion of business. In its opinion, the abolition of exchange control is an essential condition of world recovery. To obtain this, it is necessary to secure balanced budgets and to restore the confidence of the foreign lending markets to prevent sudden withdrawals of short-term debts.

The Commission considered that there must be greater freedom of international trade and recalled that one of the most significant features of the present crisis is the fall which has occurred in the value and physical volume of world trade. Governments should set themselves to re-establish the normal interchange of commodities and every effort should be made to secure a general agreement for the progressive relaxation and the complete abrogation at the earliest possible date of such restrictions as prohibitions or quotas imposed on trade as a result of the crisis. In addition, it is necessary to reduce excessive tariffs. The Commission rightly concluded that any action in the direction of a return to freedom of trade has an intimate bearing on the stabilisation of currencies, as it is impossible to maintain the international monetary system except on the basis of an international economic system. In this respect the great creditor nations have a special responsibility.

The methods proposed by the experts for the restoration of world currencies are that countries on the gold standard should pursue a liberal credit policy, while those not on gold should smooth out short-term exchange fluctuations and avoid competition in exchange depreciation. When the gold standard is restored, the gold reserve requirements of central banks should be lowered while some countries should avoid demands upon the world's gold supply by adopting an improved system of the gold exchange standard. In assisting the smooth working of the gold standard, the Commission assigned an important part to the Bank of International Settlements. The general tenor of the experts' recommendations is an early and general return to an improved gold standard under such conditions as will provide safeguards against future disastrous fluctuations in the value of the monetary metal and secure a rise in world prices.

In all the opening speeches at the Conference, it was generally agreed that the problems to be solved are to stabilise currencies in relation to some common international standard, to remove barriers to world trade and to raise world prices. Equally important, all were agreed that there must be an end to the prevailing conflict of national economic policies.

Nothing in these suggestions is really new and indeed it would be surprising if it were so, for ever since the depression began the whole world has been searching for remedies. But it is much to the good that the problems have been clearly realised and frankly stated. Now the real work of the Conference begins, and that is to work out the details and secure the adoption of practical policies which will lead to the amelioration of the world crisis. General Smuts urged that when the delegates had the reports of the technical committees before them, they should not make too much of their political difficulties but should face the issues fairly and squarely on their merits. It is much to be hoped that this will be done. The great need to-day is the restoration of world confidence, and if the Conference can do anything to achieve this, its labours will not have been wasted. To-day the nations are bound together in a world economy wherein the prosperity of each nation ultimately is bound up with the prosperity of the world as a whole.

Sir Charles Parsons

Charles Parsons: his Life and Work. By Rollo Appleyard. Pp. xiii+334+17 plates. (London: Constable and Co., Ltd., 1933.) 15*s.* net.

IT is related that when the famous little *Turbinia* was taken to France during the Paris Exhibition of 1900, Augustin Normand, the eminent naval constructor of Havre, after meeting Parsons, remarked of him "Il ne pense qu' a' la turbine; il y pense sans cesse".

For nearly twenty years, Parsons had been absorbed in the development of the steam turbine; for another thirty years it was the chief interest of his life; and it is for his work on the turbine and the turbo-generator that he will be remembered. Although its possibilities were entirely unforeseen by any of his early contemporaries, Parsons' steam turbine led to a revolution in the production of power, in the methods of generating electricity and in the propulsion of ships. In later years his reaction turbine had serious rivals in the impulse turbines of de Laval, Curtis, Rateau and others, but a study of the history of turbines and the many problems connected with them only increases our admiration for his brilliant pioneering work, and reminds us of the profound influence his investigations had on subsequent developments.

The value of any memoir of Parsons must therefore depend largely on the light it throws upon the inception of his remarkable invention and the steps by which the seemingly insuperable difficulties were overcome, and also upon the effect the introduction of the steam turbine had on the problem of power. Judged by this standard, Mr. Appleyard's book is a most welcome addition to the literature of the subject and one which can be read with pleasure even by those who are not engineers by profession. Parsons himself and his colleagues, from time to time in their various papers and lectures, dealt with the progress of turbine machinery, but to these reviews Mr. Appleyard has been able to add those personal records from which we are able to gain an insight into the methods by which success was attained.

Though Parsons started with exceptional advantages, the path he chose was by no means an easy one and the obstacles he encountered might well have discouraged the most dauntless. But no task was too hard; no problem too complex. He had "immediate insight into requirements" and, as Mr. Appleyard says, "When due thought had been bestowed upon a design, when due care had been exercised in construction, he put his work to the test with determination and courage".

While it may be said that Parsons never ceased to think of the turbine, his versatility as an inventor and his insight into physical problems was shown in many ways. Quite early in his career, following in his father's footsteps, he applied himself to the manufacture of mirrors for searchlights, and towards the end of his life found an outlet for some of his energy in the construction of large telescopes. From long experiments on the artificial production of diamonds, he could turn to the invention of the auxetophone, a form of air-operated loud speaker which was used for a season at the Queen's Hall concerts, and to the "great engineering attack on a problem of geology", the sinking of a shaft in the crust of the earth twelve miles deep.

With all these matters, Mr. Appleyard deals with sympathy and understanding, as he does also with the character and career of Parsons. In some respects the story of Parsons is unique. An aristocrat by birth, at Birr Castle, at Dublin, at Cambridge and at Elswick, he came into contact with men of science and engineers of the first rank and with these he quickly took his place. It is true he was only one of many who attacked the urgent problem of the high-speed engine, but he was the first to solve successfully the problem of the steam turbine. By the time he was thirty years of age he had made his first turbo-generator, at forty he was applying the steam turbine to propulsion and at fifty he saw his turbine the successful rival of the triple expansion engine on land and sea.

The story of how Parsons lost and then recovered the control of his patents relating to the parallel-flow turbine is of absorbing interest. To Messrs. Clarke, Chapman and Co., with whom for five years, 1884–89, he was a junior partner, the patents without Parsons were of little value; to him they were everything, and when, through the efforts of Lord Moulton, Sir Dugald Clerk and Sir Alfred Ewing, he regained control of them, the future was assured. From that time onwards there was no looking back. At the time of his death, as Mr. Appleyard says, the total output from turbo-generators constructed by the Parsons firm, and by their licencees, for land purposes alone, exceeded thirty million horse power. But this is only half the story, for the horse-power of turbines of the Parsons type constructed for naval vessels and ships of the mercantile marine runs into many more millions.

One or two misprints, such as "Bellis" for "Belliss", and "*Sohol*" for "*Sokol*" have been overlooked in the proofs of the book, and for some reason reference is made to "Sir" George and "Sir" Robert Stephenson, which surely is a mistake. These are but trivial blemishes in an admirable memoir.

Tabular Data of Science

Annual Tables of Constants and Numerical Data: Chemical, Physical, Biological and Technological. (*Tables annuelles de constantes et données numériques de chimie, de physique, de biologie et de technologie.*) Vol. 8: *Années 1927–1928.* Part 1. Pp. xl+1101. Part 2. Pp. xxi+1102–2706. 500 francs. Vol. 9: *Année 1929.* Pp. 1+1607. *Tables des matières du Vol. 9, année 1929.* Rédigée par G. Kravtzoff. Pp. xxiv+124. Vol. 9, with Index, 400 francs. (Paris: Gauthier-Villars et Cie; New York: McGraw-Hill Book Co., Inc., 1931–1932.)

THESE volumes of the "Annual Tables", and especially vol. 9 containing the data recorded during 1929, have several features of interest and importance. Their binding is the familiar dark green cloth that clothed their predecessors, but there are interesting differences in their content. Vol. 1 of the series contained the data published during 1910 and was in many respects an experiment; it was clear that some such annual compilation was an urgent need in every scientific library, but the best way of presenting the data, the best way of arranging chemical compounds of all types and all the editorial details, could only be reached by experiment and with the help of friendly criticism. As the succeeding volumes appeared, alterations and improvements were made. Then the War came and, as happened to most international experiments, publication had to be suspended.

After the War, Dr. Marie and his staff were faced with a terrifying accumulation of data to be sifted, arranged and printed; they must have felt that to catch up with the ever-increasing mass of material was an almost hopeless task. They continued, however, and each volume that has appeared has shown some improvement on its predecessors. With the publication in 1931 and 1932 of the volumes under review, they have caught up with the data to the end of 1929, and have in addition produced a volume, vol. 9, which can be taken as their most polished product incorporating the lessons of nearly twenty years' experience.

The most important and striking feature of this last volume is its accompanying index. Compilers of comprehensive tables of numerical data are faced with one grave difficulty: the material must be arranged on some logical plan and, because of the enormous variety of properties measured and of substances examined, the plan itself must become a trifle complex. Such tables, however, are valueless unless they are used and the user, especially the occasional user, is apt to regard the plan in a rather different light from that intended. It seems to him at times to be a barrier that encumbers his way to the facts that he desires. He must obtain some knowledge of the plan before he can make use of the volume, and if he is in a hurry, and particularly if he cannot find what he wants, the plan, however logical, becomes a source of irritation. (It was in the United States that the reviewer heard a valuable compilation referred to as the "Intentionally Cryptical Tables".) This difficulty is, of course, most marked in a compilation as comprehensive as the "Annual Tables"; Richter's "Lexikon der Kohlenstoff-Verbindungen" can have one all-embracing plan and a knowledge of it is an integral part of the technique of the organic chemist; but no one plan can embrace all the sections of the "Annual Tables".

This unfortunate state of affairs is, however, completely altered by the existence of an efficient index volume such as that which accompanies vol. 9. In the main work the data are arranged, as they must be, in sections dealing with the various properties of substances and the phenomena they present. The index volume is the complement to the main work and gives alphabetical and formulæ indexes of all the substances examined during the year covered. Thus all users are satisfied, and particularly the user who wishes to know whether the density of a certain compound or the conductivity of a certain solution has been determined; he need no longer wade through lists of densities or of conductivities; reference to the index volume will tell him at once if the data in which he is interested are included or not, and if they are, precisely where to find them.

The index itself requires a system, but the one adopted will commend itself to everyone. It is based on the world's past experience in similar tasks; it incorporates bodily well-established systems such as that of Richter and Stelzner for the organic compounds; it is lucidly explained in the four more important European languages and is helped out by a plentiful supply of polylingual cross-references. The compilation of this index volume must have been a considerable labour, but the reward of gratitude will be great.

Other points to which attention may be directed are, first, that nowadays the whole text is given in both French and English. The advantage gained by this is not so marked in many of the sections dealing with the purely scientific data as it is in the more technical chapters. The vocabulary of the French physicist is to a large extent almost the same as that of his English colleague, their words coming from a common Latin root; but the engineers must at times have difficulties in understanding each other's technical terms, and these difficulties the bilingual text removes. Secondly, it should be noted that libraries or individuals whose interests are confined to one field alone are catered for, in that most of the more important sections can be purchased separately. The third and most important point is the price at which these volumes can be obtained; vol. 9 with its index at the present rate of exchange costs something well under £5 and contains more than seventeen hundred pages of compressed and complicated printing. This is a ridiculously small sum and it is sincerely to be hoped that the financial state of the world will not lead to the withdrawal of the grants from the various participating countries which make it possible to publish the "Annual Tables" at such a low price.

Finally, it may be noted that the present trend of physics is reflected in the facts that data on emission and absorption spectra occupy more than a quarter of both the volumes under review, and that the Raman effect, which was given three and a half pages of the chapter "Scattering of Light" in vol. 8 (1927 and 1928), has monopolised that chapter in vol. 9 (1929) and has demanded thirteen pages.

T. W. J. T.

Statistical Tables

Tables for Statisticians and Biometricians. Edited by Prof. Karl Pearson. Part 1. Third edition. Pp. lxxxiv+143. 15*s*. net. Part 2. Pp. ccl+262. n.p. (London: Biometric Laboratory, University College, 1930–1931.)

STATISTICIANS have for long been familiar with Prof. K. Pearson's "Tables for Statisticians" as the standard exposition of the theoretical conceptions and practical procedures adopted by the Biometric Laboratory at University College. The handsome and expensive production of the tables, and the abundant introductory matter, were features which, from its first appearance, compensated for the partial or personal tone which characterised the treatment of controversial topics.

In the course of time, as was inevitable, certain extensive tabulations have been found to be of less use than was originally hoped, and others, based on faulty theory, have been shown to be definitely in error. It is the most serious fault of this new edition that no account seems to have been taken of these changes. Thus Tables 17, 18 and 19, concerned with the calculation of the probability of deviations from proportionality in a 2 × 2 table, are printed without change from the first edition, although it is now recognised, almost if not quite universally, that the use of three degrees of freedom in place of one is definitely erroneous.

Part 2, of which this is the first edition, is an even larger volume. The introduction occupies 250 pages, and the tables 262. Many tables supplement or enlarge those given in the first volume, and it would have been of great advantage to the user if the matter had been re-arranged so as to bring together tables dealing with the same function. Thus the reader of Table 30 of Part I is not told that, under a different title, sixty pages of Part 2 (Tables 8 and 9) contain a fuller and more accurate table of the same function.

The utility of some tables would have been greater had their nature not been disguised by the special terminology of the Biometric Laboratory. Thus a good, though truncated, table of the derivatives of the normal probability function (Table 7) is termed "Table of the First Twenty Tetrachoric Functions", owing to the accident that these functions were at one time used in the Biometric Laboratory for estimating the correlation coefficient from a 2 × 2 table. Others, such as the fifty-seven crowded pages devoted to Table 3 (more than 70,000 entries), seem like elaborate attempts to make available a cumbrous method of approach to problems already more simply solved.

Among the more useful tables should be mentioned Table 2 of the second part, giving the abscissæ and ordinates of the normal curve, and certain important ratios, arranged as in Prof. Kelley's textbook of "Statistical Method". The table is to ten figures and based on Sheppard's extensive tables, as yet unpublished, of the probability integral. Table 7, which we have already mentioned, will also be useful, though in the introduction the reader is warned against this heresy, in constructing curves from their Charlier expansions.

As a collection of the labours of the Laboratory the work is monumental. Like other ambitious monuments, however, it invites criticism at a number of points. R. A. FISHER.

Short Reviews

Man and Medicine: an Introduction to Medical Knowledge. By Dr. Henry E. Sigerist. Translated by Margaret Galt Boise. Pp. x + 340. (London: George Allen and Unwin, Ltd., 1932.) 12*s*. 6*d*. net.

DR. HENRY SIGERIST, who in 1925 succeeded the veteran Sudhoff as professor of the history of medicine in the University of Leipzig and has recently followed Dr. W. W. Welch in the corresponding chair at Johns Hopkins, has written a work which will be of value not only to the medical student for whom it is primarily intended but also to the layman interested in medical history and doctrines.

The work is divided into seven chapters. The first deals with man in his anatomical, physiological and mental and spiritual aspects with special reference to the work of Vesalius, Harvey, Freud and Jung. In the second chapter the sociological aspects of disease and the behaviour of the sick man are considered, with a comparison between the conception of disease in ancient and modern times. In the following chapter, entitled "Signs of Disease", the author shows that symptoms and disease are not identical conceptions but that symptoms are manifestations of disease, occurring in combination or following one another successively during the course of the disease. The fourth chapter is devoted to the consideration of the development of the various conceptions of disease throughout the ages, general theories of disease, the study of special diseases, the course of the disease, and its incidence and mortality. In the fifth chapter the causes of disease are discussed under the headings of external causes such as physical influences, food and drink, bacteriological and mechanical agencies, and internal causes, such as disposition, constitution and heredity. Medical aid, which forms the subject of the sixth chapter, is considered from the threefold aspect of diagnosis of the diseases, treatment and prevention. The last chapter contains a short historical account of the physician in ancient Egypt, classical antiquity, the Middle Ages, the Renaissance and modern times, a consideration of the subject of sick insurance, professional secrecy and medical ethics.

A word of praise is due to Miss M. G. Boise for the excellence of her translation.

Architectural Acoustics. By Prof. Vern O. Knudsen. Pp. viii + 617. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 40*s*. net.

THIS massive volume admirably illustrates the manner in which a specialised physical subject, even in 'non-atomic' physics, may rapidly proceed from a very unsatisfactory rule-of-thumb stage to a stage in which one may obtain some definite measure of guidance from an appeal to fundamental principles. This particular subject, which owes its existence in great measure to the pioneer labours of the late Prof. Sabine, is developed by the author in a very competent and comprehensive manner.

The book is divided into three parts. The first part, consisting of about a hundred pages, is devoted to the study of physiological and physical acoustics. In the second section, the fundamentals of the special part are developed, a series of chapters being devoted to reverberation, and to the absorption, insulation and amplification of sound. This part concludes with a discussion of the acoustics of auditoriums, speech halls and music rooms. The third part deals with the application of these principles to building design.

Two very useful features of the book are a series of problems on which the student may exercise his skill, and a list of clearly phrased definitions of terms used in acoustics, together with an expression of the units in which the quantitative magnitudes concerned are measured. We may not always agree with the author's usage; in particular we note that he is not a member of that guild of stern logicians which insists that a sensation loudness can not be made the subject of measurement. But there is no denying the value of such a list, and it is greatly to be desired that other authors should adopt this very useful practice. A. F.

Classical Descriptions of Disease: with Biographical Sketches of the Authors. By Prof. Ralph H. Major. Pp. xxvii + 630. (London: Baillière, Tindall and Cox, 1932.) 30*s.* net.

THIS fine volume, the composition of which was inspired by Long's "Selected Readings in Pathology" (see NATURE for March 29, 1930, p. 488), contains the original descriptions of various diseases, translated when necessary into English, from classical antiquity down to the present day. After an introduction containing passages from Hippocrates, the work consists of ten parts devoted respectively to classical descriptions of infectious diseases, diseases of metabolism, lead poisoning, diseases of the circulatory system, diseases of the blood, kidney diseases, respiratory diseases, deficiency diseases, allergic diseases and diseases of the digestive system. A short biographical notice is prefixed to each writer's account of the disease.

The extracts are not confined to the works of dead writers but include passages from the works of Charles Nicolle and his collaborators on the transmission of typhus by the louse, of Banting on the internal secretion of the pancreas, of Pierre Marie on acromegaly, of Leo Buerger on thrombo-angeitis obliterans and of Herrick on sickle-cell anæmia.

Dr. Major is to be congratulated not only on his selection but also on his excellent translation of a considerable number of the descriptions of disease by foreign writers. The work will be of special value to the large number of readers who take an interest in the history of science, medical and otherwise, but have not the time or the means to consult the original volumes, many of which are difficult of access. The text is liberally interspersed with portraits, facsimile pages and other illustrations.

The Causes of Accidents: Three Lectures on Recent Research into the Causes of Accidents given at the Royal Society of Arts under the Heath Clark Bequest to the National Institute of Industrial Psychology. By Eric Farmer. Pp. vii + 88. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 3*s.* 6*d.* net.

IN this important little book Mr. Eric Farmer examines critically all the alleged causes of accidents and concludes that, even allowing for chance and for biased liability as factors, there are some people who are inherently more liable to accidents than others. As the people with a high accident rate also tend to have a high sickness rate and to be less efficient, he thinks that these are the people who find modern industrial conditions too great a strain. Accident-prone people should, if possible, be employed in occupations where there is little risk. For this to be effective, careful and detailed records of accidents in various occupations are needed and further research along the lines already started by Mr. Farmer into those personal factors which, the evidence shows, play such an important part.

Physik: ein Lehrbuch für Studierende an den Universitäten und technischen Hochschulen. Von Prof. Wilhelm H. Westphal. Dritte Auflage. Pp. xvi + 596. (Berlin: Julius Springer, 1933.) 19.80 gold marks.

THIS edition is an enlargement of the second, while less important matter has been omitted or compressed. The electrostatic and electromagnetic systems of units are retained, the change to international units having been considered and rejected.

It is a very useful book but somewhat uneven in treatment. For example, thermoelectricity, electrolysis and geometrical optics are less fully treated than electromagnetics, interference and wave theory.

Some parts are very elementary while the more advanced parts such as quantum theory, wave mechanics, etc., are only given in outline. Between these extremes the matter is very good.

The A B C of Chemistry. By J. G. Crowther. Pp. xi + 248. (London: Kegan Paul and Co., Ltd., 1932.) 4*s.* 6*d.* net.

THIS interesting and well-written little book offers a readable summary of some of the broad principles of biochemistry and of the contribution of chemistry to modern civilisation, as is indicated by such chapter headings as "The Breath of Life", "Food", "Vitamins", "Soap", "Dyes" and "Metallurgy". It is accurate in general; but the original synthesis of alcohol is wrongly ascribed to Berthelot, and such obvious misrenderings as "Wolbe", "Erlich", and "Sully" appear in text and index alike. A very generous view is taken of Mayow's contribution to chemistry. The implication (p. 81) that chemical symbols are synonymous with 'jargon' is supererogatory, as is also the prefatory suggestion that teachers of chemistry do not need to make their subject attractive.

Principles of Pharmacy. By Henry B. Mackie. Pp. xi + 281. (London: J. and A. Churchill, 1932.) 10*s.* 6*d.*

THIS is a sound and comprehensive manual which will be found very useful by students of pharmacy. Its scope is indicated by the titles of the main sections: solution, disperse systems, change of state, extraction, enzymes, sterilisation. The book is well illustrated, contains many practical directions, and is provided with a useful bibliography.

The University of London and the Development of Science

THE laying of the foundation stone of the new buildings of the University of London by His Majesty the King on June 26 will mark, in more than one sense, the beginnings of a new chapter in the development of the University. The centenary of the University of London is still distant by some three years, by which time presumably some part of the great new buildings in Bloomsbury should be in occupation, but the years which have passed since its Charter was granted in 1836 have been years of remarkable development. Beginning as an examining body only—a product of the compromise so dear to British Governments—and occupying for the greater part of its existence an anomalous position in the university world, it has during the present century found itself as a great federal university with a huge student population, a great number of distinguished teachers and investigators, and an impressive and growing record of achievement in scholarship and research.

Limited as it was to the duty of examining candidates who presented themselves for its examinations, the University nevertheless gave scientific education a vigorous impulse by according recognition to subjects which, at the best, had hitherto only been regarded as poor relations in the other universities of Great Britain and, at the worst, had been ignored altogether. This is true not only of the well-known Matriculation examination, which had such a profound effect on secondary education in the nineteenth century, but also of the higher examinations of the University. In medicine, for example, from a fairly early stage, great emphasis was laid on the fundamental pre-clinical sciences. It was the first university to establish degrees in science and thus give academic recognition to the science teaching which was being given in London and the provinces.

The strong interest shown by the University in the recognition and advancement of science was no doubt due very largely to the composition of its governing body. This was appointed during a great part of its existence by the Crown and it included a large proportion of fellows of the Royal Society. Among the 'fathers' of 1836 were Airy, Neil Arnott, Beaufort and Faraday, and it is well known that the last-named played a very active part in the affairs of the University. Later there were such famous names as Hooker and Huxley, Lister, Paget and Sharpey; and among its vice-chancellors were Lubbock and Roscoe.

But examinations however well designed and governing bodies however distinguished can only indirectly foster and encourage science and learning. The examining University had (and still has) in the Brown Institution a small institute in which some pioneer research work was carried on. Burden Sanderson, Huxley, Sherrington and Rose Bradford have given lustre to an institution of the existence of which probably few Londoners are aware. In the two great colleges, University and King's, each with a rather longer history than the University in which they were in due course to be incorporated, there were many more leaders in science. University College had from its beginning established chairs in chemistry (the first teaching laboratory in England was opened there in 1828), in geology, botany and zoology. Here, too, were established chairs in anatomy and physiology; and Sharpey, "the founder of modern physiology", sent his two famous pupils Michael Foster to Cambridge and Burden Sanderson to Oxford to spread the new knowledge. In biology, as in chemistry, physics and mathematics, there are again long lists of famous names the mere recital of which would suggest some of the most significant stages in the development of science in the nineteenth century. At King's College there were Lyell, Wheatstone and Daniell; and in those institutions which afterwards were brought together as the Imperial College of Science and Technology were Huxley, Armstrong and Unwin.

Since its reconstitution at the beginning of the twentieth century, when its functions were extended to make it a teaching as well as an examining body, the development and expansion of the University of London, especially in respect of science and medicine, have been on a very large scale. It is only possible here to enumerate some of the happenings of the last crowded years. New courses of study have been planned and new degrees and diplomas instituted. In the colleges, new departments have been called into being and existing departments strengthened, while great institutions such as the London School of Hygiene and Tropical Medicine, devoted primarily to postgraduate work and to research, have started on their course. The building up of a professoriate has been one of the most notable achievements of the University. The number of chairs in all the established physical and biological subjects has been increased and continues to increase, while especially noteworthy is the establishment in the London medical schools of the unit system with full-time directors in medicine, surgery and obstetrics. There are chairs in newer subjects, such as eugenics, genetics, social biology, dietetics, aeronautics, scientific method, chemical engineering and so on, and every academic session sees some addition to their number. The growth in research work fostered by the establishment of research funds and postgraduate scholarships has been not less remarkable. At nearly all the colleges of the University large schemes of rebuilding and extension have been carried out, and the laboratories at institutions such as University College and the Imperial College are among the best in Great Britain or indeed in Europe. The erection of a University Observatory at Hendon is also a notable departure.

It is not easy to predict the lines of future development of the University, but one thing at all events seems obvious. London is, from the nature of things, destined to become more and more a centre of advanced teaching and research. At University College, King's College and the Imperial College, there are teachers and investigators of great distinction, and there are growing up around them important schools of workers in the various branches of science. This is all to the good ; but while the complete severance of teaching from research work would be in many respects unfortunate, there is undoubtedly room for creating more research posts, the occupants of which should be freed from routine teaching. Another direction of advance may be the setting up of special institutions devoted to particular sciences. Either way has much to commend it, but either plan needs very considerable financial resources. Nevertheless, the history of the University of London does not give rise to any fear that the needs of science will be overlooked in the years which lie ahead of it.

Excavations at Tell Duweir, Southern Palestine, 1932–33[*]

THE first season's work of the Wellcome-Colt Archæological Expedition at Tell Duweir in Southern Palestine under the direction of Mr. J. L. Starkey in 1932-33, has amply justified the selection of this site for exploration. It holds out a strong assurance of substantial additions to knowledge of the archæology of southern Palestine in an obscure period at no distant date. Considerable progress has been made in demonstrating the character and relation of the works which converted the Tell into a strongly fortified position ; while the examination of the great stone structure on the summit of the mound, which made Tell Duweir unique as a surface site in Palestine, has been carried to a point which confirms the first impression of its importance.

Before giving an account of the more important results of the excavation, it will not be out of place to mention certain topographical features relating to the Tell. It lies twenty-five miles to the south-west of Jerusalem, twenty-three miles north-east of Gaza, and twenty miles from the sea to the west. The mound, of which the top is 900 ft. above sea level and at a mean height of 130 ft. above ground level, covers 39 acres at its base, while the summit has an area of approximately 22 acres. The average width is 250 metres from east to west and 300 metres from north to south. The remains of a stone revetment, which had encircled the mound, were still to be seen near the summit, while crowning the whole were the imposing remains of the stone buildings, to which reference has already been made.

Tell Duweir has been identified tentatively with Lachish, a strategic strong point of southern Palestine, which offered a strenuous resistance to Joshua, was fortified by Rehoboam, and captured by Sennacherib, and also by Nebuchadnezzar. The siege of the city by the former is depicted on a stone relief from Nineveh which is now in the British Museum. So far, the excavations have produced no positive evidence to confirm the identification, although it may be said that they have added to its probability.

The main points to which investigation was directed during the season's work were the stone revetment, the works at the south-western corner of the mound—a bastion and, it would appear, the main gateway to the city—the city walls, and the building at the top of the mound, which evidently must have been the central structure of the city keep or fortress. A habitation site on the east side of the Tell and another with a cemetery site on the north-west were examined and the latter cleared.

The clearance of the area at the north-west, which provided the greater part of the cultural objects obtained by the excavation—a lengthy operation which continued during the greater part of the time the expedition was at work—came about almost fortuitously. It arose out of the necessary operation of preparing a place for dumping the earth removed from the mound in the course of the work. It was decided to build a retaining wall which would enable the earth to be terraced and made available for future cultivation. In testing bed-rock for the line of the retaining wall, a number of cuttings were found which, on further examination, proved to be a well and rock-chambers or tombs. The well was choked with boulders, but when it had been cleared, a matter of no little difficulty, potsherds from the filling indicated that it was certainly of Middle Bronze age date. The clearance was eventually carried up to the face of the escarpment, which it was found had been cut back until it was nearly vertical, rendering the fortress practically impregnable from this side, while immediately in front of the cliff was a fosse carefully cut in the rock, running north-east and south-west, and following the line of the rock platform on which the mound stands. The fosse was of considerable depth and was only cleared finally by blasting the boulders which formed part of the filling. A cache of pottery with metope pattern with bird, of the type common at Tell el Ajjul, in the lowest levels at a depth of 38 ft. indicated the Middle Bronze age (Hyksos period) as its date.

The tombs first to be examined were found to contain potsherds of Middle or II Iron age date. Many of them had collapsed and had been reused or reroofed in Byzantine times. Both the tombs and the house foundations which lay in the habitation area over the fosse covered a considerable period of time, ranging from Middle Bronze age down even to early Christian times. One tomb can with certainty be attributed to the Hyksos period. House foundations contemporary with the nineteenth dynasty and tombs dating from the eighteenth were discovered.

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[*] This account of the excavations is based upon the reports of Mr. J. L. Starkey, for access to which we are indebted to Sir Charles Marston. The photographs are by Mr. Ralph Richmond Brown, a member of the Expedition.

In addition to the pottery, the objects recovered from this area included several bronze daggers, bronze toggle pins, bangles, anklets and rings, pottery figurines of Astarte in conventional pose, vases in alabaster and serpentine, beads of various forms and material, seals, and a number of scarabs in steatite, green jasper and carnelian. Some of the steatite examples are of fine workmanship, though of local manufacture. The pottery of certain types affords a link between series found at Jericho and at Tell el Ajjul.

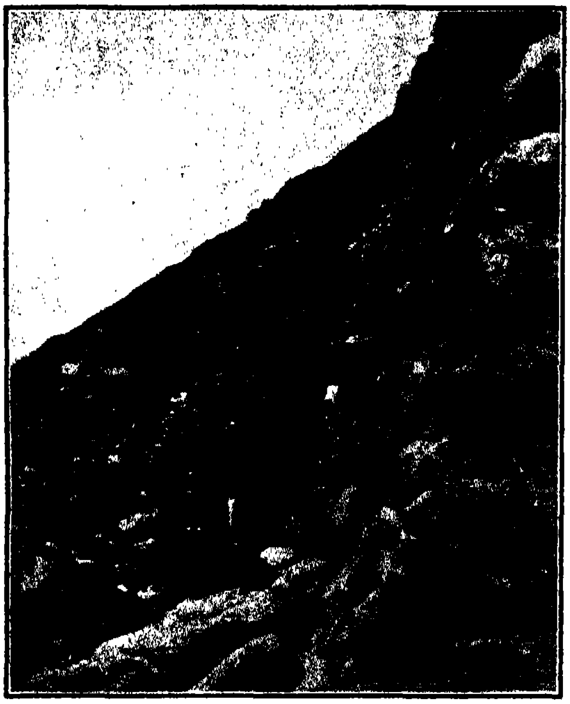

FIG. 1. Section of revetment exposed on north-east side showing stratification of debris. Burnt layer is half-way between boy's head and surface.

The first of the major operations in the examination of the fortress works was the tracing of the line of the stone revetment. This was first cleared at a point at the north-east corner of the Tell, where eleven courses of fine dry-walling, rising to a height of about 20 ft., were uncovered. Further clearances revealed interesting differences in the method of turning the wall at the four corners. At the north-west a bold sweep was supported by five buttresses with their intervening spaces filled with blocks of stone and lime forming a compact mass, a feature unique in Palestinian architecture. There was evidence at the north-east corner (Fig. 1) that this part of the fortress had been subjected to concentrated attack by enemy forces. It was found that the approximate height of the revetment actually preserved encircling the Tell was 16½ ft. and its width 6½ ft.

Within the thickness of the revetment at one point a shaft, some eight feet in diameter, was discovered, which proved to be a well, choked with boulders. This at a depth of 26 ft. cut into living rock. Water level was reached at a depth of 122 ft. and bottom at a depth of 140 ft. from the Tell surface. Immediately behind the revetment enclosing the well were traces of three walls, which probably are the foundations of parts of the internal structure of a tower.

The investigation of the area of the great bastion to the south-west proved to be a problem of considerable intricacy owing to the fact that in the removal of the blocks of stone, the dry-walling offered little guidance in following the line of structure. Eventually it was found that there were three walls running south from the great square tower standing out from the lines of fortification, while a fourth at the highest point represented the city wall. The lowest of the walls, which would appear to be contemporary with the lower revetment and of Israelite age date, was a retaining wall at the side of a ramp which carried the road leading into the city up to the gateway, while a second wall was apparently a flanking wall to the road, here 20–25 ft. wide. Of the two gateways, the left jamb of the outer has disappeared. In the walls flanking the inner gateway are the remains of towers at a distance of approximately forty-four feet apart. Abutting on one of these was a chamber which probably served as a guard room. Two iron lance-heads found nearby lend support to this view, while it was here also that a bronze crest-mount of a helmet was found (Fig. 2). This still showed traces of cloth and leather fastenings and the rivets by which it was affixed to the casque. Its purpose was determined only after some deliberation ; but

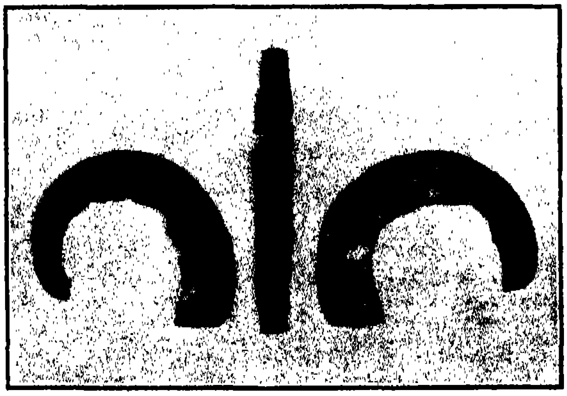

FIG. 2. Bronze crest-mount (two sides) of a helmet, with connecting spacer.

its resemblance to this part of the soldier's helmet as shown in the British Museum relief (Fig. 3) proves its character beyond doubt.

It is of interest to note that the defensive walls, here as elsewhere in the fortress, show that the method of defence was by shallow recessments in the wall rather than by the more usual deep re-entry. This corresponds with the form of defence shown in the British Museum relief.

It is possible to do no more than refer to the interesting habitation site on the eastern side of the Tell, which in the nineteenth dynasty marked the most prosperous period of the city's occupation, and yielded evidence of Egyptian contacts, in order to pass on to the examination of the remains at the summit of the mound. This was undertaken towards the close of the season, but sufficient time was available to reveal that here were the ruins of two structures, of which the earlier had been levelled and used as a platform for the erection of the later building. The ruins of this again had been used later by squatters. It was found that the walls of the later and smaller building, which it may be conjectured was the governor's residency, did not follow the lines of the earlier building, with which its plan had no relation. At north and south the levelled portion of the earlier building projected to form a platform. The residency had contained a large number of public and private rooms and offices with an open courtyard. This latter was probably open to the sky, as it was not filled with limestone blocks as were the spaces representing the other rooms. Some of these blocks showed a curvature which points to a barrel-roofing. The dating of this building is not yet fixed archæologically; but certain considerations point to fourth to fifth century B.C.

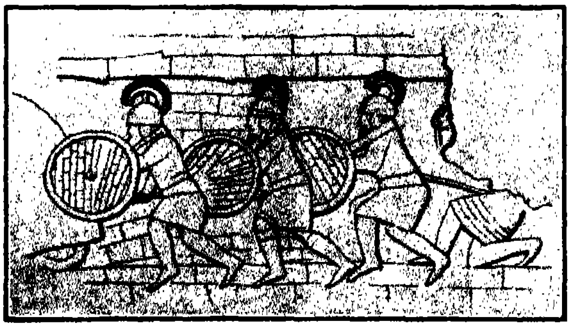

FIG. 3. From bas-relief of the siege of Lachish showing helmets worn by Assyrian soldiers. [*By permission of the Trustees of the British Museum.*]

Two further problems arising out of the excavation remain to be mentioned. These, it is perhaps not unfair to say, constitute the main contributions of the season's work to the discussion of the historical question raised by Tell Duweir. In examining the defensive works of the fortress and in removing the earth from the face of the revetment, evidence was found that the walls had been breached in two, or possibly three, attacks. The breaches had been repaired, although usually with little skill or care; but the defences had afterwards been subjected to the effects of a serious conflagration. In the stratification, this conflagration was represented by a stratum consisting of calcined limestone and charcoal in which were the remains of tree trunks of considerable size. It is suggested that earlier breaches in the defences were made during the siege by Sennacherib, dated tentatively at 701 B.C., while the evidence of conflagration bears witness to the more thoroughgoing methods of the army of Nebuchadnezzar in 586 B.C., which, cutting down the trees on the neighbouring hills and in the olive groves, piled the trunks against the walls and set fire to them, utterly destroying the city's defences in its lines of attack.

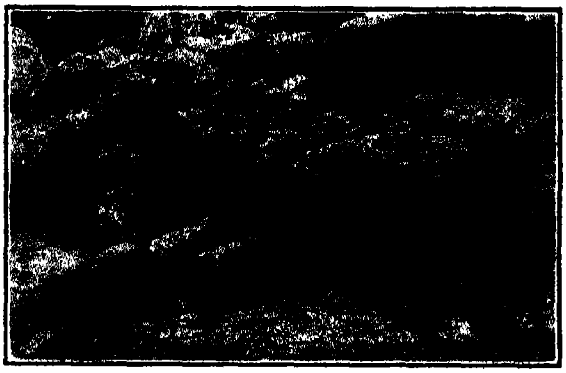

FIG. 4. West wall of residency lavatory and bathroom, showing sanitary fitting and, on left, drain from bath room.

Attention was directed to the second problem in the course of the excavation by the occurrence of burnt brick in the debris at various points, as well as by traces of burnt brick building in the area of the well in the revetment to which reference has been made above. The problem was resolved up to a point by a section through the city walls near the bastion, where it was found that an earlier system of walls constructed of unbaked mud brick lay on a foundation of stone below the late city walls. The width of the walls, 19 ft., points to their substantial character.

It remains only to mention briefly the result of a complete section taken down to bed rock through a depth of 38 ft. of deposits. This section showed that the deposits of the lowest 10 ft. belonged to early Palestinian culture; and it provided a complete and unbroken series of potsherds from the third millennium B.C. down to the close of the city's occupation. Among the early wares are examples of the almost unknown black burnish ware, hitherto discovered only in the Jordan valley, which shows resemblances to the ware of predynastic Egypt produced by the muffled technique. For this Tell Duweir now affords a new southern limit of distribution in Palestine.

An exhibition of the antiquities found during the excavations will be held in London during July.

Problems of British Forestry

IN a lecture to the British Science Guild at its annual general meeting held in the Mansion House, London, on June 19, Prof. R. S. Troup discussed the important question of forestry in Great Britain, with special reference to the programme of State afforestation now being carried out by the Forestry Commission, its progress to date, its limitations, and some of the scientific and technical problems following in its train ; he also reviewed the question of private forestry and pointed out some of its defects. The significance of British forestry at the present time may be realised from the fact that less than five per cent of the requirements of Great Britain in timber are met from home-grown sources, that the forest capital of the world is being consumed at an alarming rate, and that the shortage of timber which is likely to result may cause much distress in the absence of a supply of home-grown timber.

Dealing with the planting scheme of the Forestry Commission, Prof. Troup explained that the afforestation of large tracts of bare land with species which are in many cases exotic, introduces problems of a complicated nature ; these are investigated by a special research branch of the Forestry Commission aided by certain universities and particularly by the Imperial Forestry Institute at Oxford. Among these problems, not the least important are those relating to soil conditions, such, for example, as are met with on the heath lands which form a considerable portion of the area available for forestry : on such lands the soil tends to become degraded owing to the leaching out of the soil nutrients in a climate where precipitation exceeds evaporation, with the result that the establishment of tree-growth is often difficult. In such cases deep ploughing has proved successful on an experimental scale. On peat lands good results have been obtained by draining and planting on square turfs dug out of the drains and placed in an inverted position on the surface of the ground ; by this means the turf becomes oxidised and breaks down, liberating nitrogen and other essential nutrients. Experiments in the use of basic slag have given remarkable results on very unfavourable peat soils.

Research in Great Britain on the control of pests and diseases is mainly centralised at the Imperial Forestry Institute at Oxford. In forestry, direct measures for the control of insect pests, such as trapping, grease-banding, and hand-collection may prove too costly, and special attention has to be directed towards preventive measures of a sylvicultural character, such as the avoidance of large areas of pure crops, the removal of sickly trees forming breeding centres for noxious insects, and the barking of newly-felled coniferous trees in order to prevent the multiplication of destructive beetles which lay eggs in their bark.

Increased attention is being directed to methods of biological control for dealing with forest insect pests. In this connexion, an interesting study has recently been made of the life histories of the *Sirex* woodwasps which bore into living coniferous trees, and of their parasites, the large ichneumonid, *Rhyssa persuasoria*, and the smaller cynipoid, *Ibalia leucospoides*. As a result of this work, larvæ of the *Rhyssa* parasite have been exported in numbers to New Zealand by the Parasite Laboratory at Farnham Royal in an attempt to deal with an epidemic of woodwasps in the coniferous plantations there. Similar studies are being made of the parasites of the pine bark-beetle, *Myelophilus piniperda*, and the oak leaf roller moth, *Tortrix viridana*, which causes extensive defoliation and mortality among oak trees.

With regard to fungal and bacterial diseases, important work is being carried out on predisposing causes, among which frost promises to be of more importance than has hitherto been suspected. The oak rot disease caused by the fungus *Stereum spadiceum*, which has resulted in extensive loss in the Forest of Dean, furnishes an example of the complicated character of some of these predisposing causes. Investigations carried out so far indicate that the ingress of this fungus is due in part to the fact that, in the days of wooden ships, oak trees were widely spaced to encourage the growth of large branches for the production of curved shipbuilding timber. Later, when wooden ships were abandoned and the value of the trees lay in the bole rather than in the branches, the oaks were left to crowd each other. The lower branches thus died off, and through the dead wood the fungus gained admission to the interior of the bole, causing its decay.

The progress made so far in carrying out the State afforestation programme in Great Britain has been good, but in Prof. Troup's opinion the programme itself needs reconsideration, since it was formulated during the War, and is based primarily on questions of national security. During the years following the War, other weighty factors have forced themselves into prominence, including the prospect of a world shortage of timber and the question of unemployment. The time has now arrived, therefore, when the forest policy of Britain should be reconsidered on a wider basis. Private forestry is in an unsatisfactory state, a large percentage of the private woodlands being unproductive to a greater or less extent, while scientific forest management is the exception rather than the rule. This is probably due in some measure to the fact that most of our woodland estates are too small to form economic units : a possible remedy would be to work on a co-operative basis with trained forest managers in charge of groups of estates. Legislation may even be necessary, as in the case of certain Continental countries, to provide for the management of private woodlands on approved lines and the compulsory reafforestation of felled areas.

Obituary

SIR ERNEST MOIR, BT.

WE regret to record the death, which occurred on June 14, at the age of seventy-one years, of Sir Ernest William Moir. Born on June 9, 1862, Moir in the early part of his career came into close contact with Fowler, Baker, Arrol, Wolfe-Barry and other eminent civil engineers and during his long and distinguished career as a partner in the firm of Messrs. S. Pearson and Son, Limited, worthily upheld the high traditions of those who, as contractors, are responsible for carrying out works of the greatest magnitude. Both in his presidential address on "Engineering Difficulties" to the Junior Institution of Engineers in December, 1929, and his address entitled "The Interdependence of Science and Engineering, with some Examples", given as president of Section G (Engineering) at the Bristol meeting of the British Association in 1930, he made many interesting references to some of the important undertakings with which he had been associated; and as "the first contracting civil engineer who has been honoured by the British Association", at Bristol he appropriately dealt at considerable length with the economics of engineering construction. Another section of his address was devoted to the bacteriological and entomological sciences and their influence on civil engineering.

Educated first at University College School, and then at University College, London, where he studied under Kennedy and Vernon Harcourt, Moir began his practical training in the yards and shops of Messrs. R. Napier and Sons, Glasgow, of which Dr. A. C. Kirk was the manager. His first important task was the building and launching of the large caissons for the foundations of the Forth Bridge. Joining the staff of Messrs. Tancred, Arrol and Co., he was employed on the construction of the south cantilevers of the bridge and then through Sir Benjamin Baker was sent in 1889 to New York to assist in the completion of the Hudson River (North) Tunnel which had been started in 1874, only to be abandoned in 1888. It was in connexion with the work on this tunnel that he introduced the use of recompression chambers for men working in compressed air. The use of this medical air lock reduced the death-rate among the staff, which in 1890 had been 25 per cent per annum, to 1½ per cent.

By this time, Moir had become a member of the firm of Messrs. S. Pearson and Son, of which the late Lord Cowdray (1856–1927) was long the head, and as such he was responsible for the construction of the Blackwall Tunnel beneath the Thames, a difficult piece of work successfully completed in 1897. Afterwards, Moir was connected with the construction of the four railway tunnels under the East River from New York to Long Island and with harbour work at Seaham, Dover and elsewhere. His latest important undertaking was the construction of the great breakwater at Valparaiso, founded in 187 ft. of water. The base of this breakwater consists of a huge bank of deposited sand, while the upper part of the structure is composed of 60-ton concrete blocks interlocked with each other. An account of this work was given to the Institution of Civil Engineers in December, 1931, by Mr. W. F. Stanton.

Appointed a member of the Admiralty Engineering Committee in 1912, from 1916 until 1919 Moir held important positions under the Ministry of Munitions and in 1924–25 was chairman of the Government Committee on New Methods of House Building. He was made a baronet in 1916 and is now succeeded in the title by his younger son, Capt. Arrol Moir.

News and Views

Prof. Manne Siegbahn

AT a meeting of the Physical Society held on June 16 the tenth Duddell medal was presented to Prof. Wolfgang Gaede (see NATURE of Feb. 11, p. 195). The presentation was followed by the delivery of the eighteenth Guthrie lecture by Prof. Manne Siegbahn, professor of general physics in the University of Uppsala, on "Studies in the Extreme Ultra-Violet and the Very Soft X-Ray Region". It is largely due to Prof. Siegbahn's technical and experimental skill, backed by a wide knowledge of physical science, that our present acquaintance with atomic structure has made such remarkable progress. In 1912, von Laue first gave experimental proof that the X-rays resembled light in all respects except that the lengths of their ether waves were many thousands of times shorter. His method was based upon the supposition that the ordered array of the atoms in a crystal would act upon X-rays just as, in familiar ways, a grosser array of particles or lines or obstructions of any kind act upon the longer waves of light, so causing such phenomena as the halo round the moon, or the colours of mother of pearl, or the iridescence of wings and wing cases of certain insects. The successful experiment at once opened the way to two separate lines of research, both of which have been rich in results. The first has led to our rapidly growing knowledge of the crystalline state of matter, including the bodies which are crystals *par excellence*. The other was first followed by Moseley and Darwin, who employed the new methods in the investigation of the X-rays themselves.

IT was then that Siegbahn, following the same line of research, began his investigations. He effected improvements in the design and construction of apparatus for measuring the wave-lengths of X-rays which have endowed them with an accuracy comparable with the corresponding optical instruments. It is amazing to look back over the last twenty years to the experiments with which this work began, and to compare their crudity, which nevertheless could not hide their obvious importance or the magnificence of their promise, with the finish of to-day. It is largely to Prof. Siegbahn that we owe the modern precision, and the fulfilment of that promise. His extremely accurate measurements of the lengths of the waves which the various atoms emit, serve as definite indications of their internal structure, and every improvement has brought new and valuable information. Not often has refinement of instrumental design and use brought such a plentiful and immediate harvest. It is interesting to note that it was Ångstrom, also a Swede, who first realised the accuracy in optical measurements which necessitated the choice of a special unit of length for their description. Ångstrom himself measured the lengths of waves of light and found them to be a few thousand of his units: the wave-lengths of X-rays are of the order of a single unit.

Dr. Michael Polanyi

DR. MICHAEL POLANYI has accepted a chair of physical chemistry in the University of Manchester, and will take up the post at the beginning of the next session. Dr. Polanyi, who is a Hungarian by birth, studied medicine in the University of Budapest and chemistry in the Technical High School of Karlsruhe. After service as surgeon with the Austrian forces during the War, he became assistant to Prof. Hevessy, professor of theoretical chemistry at the University of Budapest. In 1919 he returned to Karlsruhe, since when he has held posts in the Kaiser-Wilhelm Institute for Textile Chemistry, the Technical High School in Berlin, and the Kaiser-Wilhelm Institute for Physical and Electro-chemistry. Dr. Polanyi is a well-known physical chemist. His first notable research was a theory of adsorption, published in 1917; he has also made discoveries in connexion with the structure of cellulose and the mechanical properties of metals and other solids. His present investigations relate to the theoretical and experimental study of reaction kinetics and the mechanism of chemical reactions. It is this line of research which, it is anticipated, he will pursue in Manchester.

Johann Jacob Scheuchzer, 1672–1733

THOUGH as a science, the birth of geology dates only from the latter part of the eighteenth century, prior to that many men had been interested in the study of rocks and fossils and had recorded valuable observations. Among these men was the Swiss doctor, Johann Jacob Scheuchzer, the bicentenary of whose death occurs on June 25. Born at Zurich on August 4, 1672, Scheuchzer qualified as a doctor at Utrecht and paid some attention to mathematics. For many years he held a professorship in his native city. His main interest, however, was in natural history and especially in fossils and minerals. He translated Woodward's "Natural History of the Earth" into Latin and published several works of his own. Included in these was his "Itinera per Helvetiæ Alpinas Regiones" (1702–11), in which for the first time glaciers are mentioned as a subject for scientific investigation. He gave careful descriptions of several glaciers he had visited and explained their movement as a result of the infiltration and freezing of water in cracks and other spaces. He was thus the founder of the theory of dilatation, afterwards advocated by Charpentier and Agassiz. His natural history of Switzerland contains a special chapter dealing with what Scheuchzer thought were fossils left by the Great Deluge, and towards the close of his life he thought he had discovered in the beds at Oeningen, between Constance and Schaffhausen, the skeleton of one of the "infamous men whose sins brought upon the world the dire misfortune". But the supposed *Homo diluvii* was afterwards shown by Cuvier to be a reptile and it was called *Andrias Scheuchzeri* in honour of its discoverer. The specimen was presented to the Teyler Museum at Haarlem.

Vivisection of Criminals

THE BISHOP OF DURHAM set the ball of controversy rolling when he delivered the eighth Fison memorial lecture on June 15 at Guy's Hospital on "Ethical Conditions of Scientific Method". After discussing the case for and against vivisection of animals, he submitted the question whether in no case might man be subjected to vivisection in the interest of science. Dr. Henson asked if there was any objection to the vivisection of criminals who, by the law of their country, had been condemned to death. In their case, the issue of inherent rights could not be raised, for these had already been cancelled, and they were dealt with penally on this hypothesis. Why should not the punishment of a criminal take a form which was serviceable to the community? Why should he not at least be given the opportunity of making in this way some atonement for his sins against society? At present, deductions drawn from the responses of the anthropoid apes or even dogs have to suffice, where direct experiment on man would present a speedier route to knowledge. This applies to human physiology, especially of the nervous and digestive systems and in a lesser degree to pathology as regards infectivity and immunity. There is, of course, the possible difficulty to be encountered in finding an experimenter, at any rate in England, who would impose conditions which might not meet with the penal requirements. In any event, the subject bristles with difficulties the discussion of which would take up more space than is available in these columns.

International Ornithological Congress

THE eighth International Ornithological Congress is to be held at the University of Oxford in July 1934, under the presidency of Dr. E. Stresemann, of Berlin. The International Ornithological Congress was originally held every five years, but at the last Congress, at Amsterdam in 1930, when the president was Dr. E. Lönnberg of Sweden, it was decided to hold it every four years. The last meeting of the Ornithological Congress in England was at the Imperial Institute, London, in 1905, with Dr. R. B. Sharpe as president. In 1910 it was held in Berlin, and it was proposed to hold the 1915 Congress at Sarajevo, Yugoslavia, but in the meantime the War broke out and no further Congress was held until 1926, when, mainly through the efforts of Dr. Ernst Hartet, keeper at Tring Museum, it was resumed at Copenhagen. Preliminary arrangements have already been made for the 1934 Congress at Oxford, and the Rev. F. C. R. Jourdain, of the British Ornithologists' Union, has been elected honorary secretary. Dr. P. R. Lowe, of the British Museum, has been elected chairman of the executive committee, which includes Lord Rothschild, Lord Scone, Dr. C. B. Ticehurst, Dr. Sclater, and Messrs. Stuart-Baker and H. F. Witherby, president of the British Ornithologists' Union.

Delegates to the Congress will include the leading ornithologists from all parts of the world, particularly Australia, New Zealand, Argentina, Brazil, Japan, India, the United States, Canada, and all European countries. The problem of oil pollution of the sea, whereby hundreds of sea-birds, including many rare species, are annually being destroyed especially on the North Atlantic shores, will be a prominent feature of the section on bird protection, while the practice of 'ringing' as a means of tracing bird migrations will also be discussed. One of the most important items, however, is the project for founding an Institute of Ornithology at the University of Oxford, which it is hoped to develop out of the existing scheme of research in economic ornithology at Oxford, the grant for which expires in September, 1933. The new institute is intended to be a national centre for field ornithologists as the British Museum is for systematists. £8,000 is needed to run the Institute for a preliminary five years while steps are being taken to put it on a more permanent basis. An appeal will be made not only for funds but also for gifts of books, field notes and photographs, etc., for equipping it. It is also proposed to arrange at least one long excursion to study British bird life, and South Wales will probably be chosen as the area to visit though several shorter excursions are to be made. The lectures and papers are to be given in English, French, German and Italian.

New Buildings of the University of London

Under the title "The New Buildings for the University of London" (The Dryden Press) Mr. T. Ll. Humberstone has published a 'symposium', in which a contribution to Nature (July 9, 1932; p. 49) is reprinted, followed by an explanation of the plan of the proposed buildings by the architect (illustrated), and expressions of opinion from architects and laymen and a supplementary note by Mr. Humberstone himself. It will be remembered that Mr. Humberstone in his original article, after a brief summary of past difficulties and controversy connected with the accommodation of the University, expressed certain misgivings in regard to the suitability of the proposed buildings, especially in relation to the provision for scientific research. These views are now supplemented by critical comments from others. Prof. S. D. Adshead, professor of town planning in the University, for example, remarks that "if only on account of its rigidity—the system must fail". In his supplementary note, Mr. Humberstone reverts to his previous contention that the University buildings should make provision for an institute for scientific research, pointing out the unsuitability of the scheme, as well as the unnecessary expense involved, for the purpose, and discusses the bearing of the conception of the University as a federation upon the development of facilities for research as part of the equipment and organisation of the University, as distinct from its constituent colleges.

San Diego Museum

Local patriotism flourishes perennially in the United States. As part of a campaign "Know your San Diego", Mr. Malcom J. Rogers, curator in anthropology in the Museum of San Diego, has recently broadcast a lecture, in which he gave an account of the origin and growth of the collections. The nucleus of the museum was an exhibit at the Panama-California Exposition of 1915–16. The organisers of the exhibition, in consultation with officials of the U.S. National Museum, spent some three years in getting together a collection to illustrate the origin, racial types and culture of man. Expeditions were sent to Asia, Africa, South America, the Pacific and the Arctic for material and the collections then made were housed in the only permanent building in the exhibition, the California Quadrangle, which is still its name, as it had been intended from the first that what, it was hoped, would be a unique educational exhibit, should "not be a thing for the moment, but an enduring institution for the benefit of the people of San Diego and its visitors". At the close of the exhibition the collections were transferred to a permanent Museum Association in trust for the people of San Diego. Dr. Edgar L. Hewett, of the Archæological Institute of America, who had been responsible for this department during the exhibition, was made the first director of the Museum. Constant additions have been made to the collections, which are now so extensive that it is possible only to show the exhibits in rotation. They are arranged departmentally, to illustrate man's origin (by casts), physical types, and culture in the past and present. The archæology of Central America and the Mayas is abundantly illustrated, the most striking and best-known buildings and monuments being represented by replicas. The pride of the Museum, however, is the collection from the south-western States and, more particularly, that from Southern California, the latter being unique and beyond question the most complete in existence.

Bird Life on Ailsa Craig

A report on bird life on Ailsa Craig was submitted to Ayr County Council on May 30, the Earl of Glasgow presiding, following a communication from the

Scottish Office. The report, prepared by Lieut.-Commdr. G. H. Hughes-Onslow, Barr, and Mr. T. Smith, Maybole, recommended that protection be given to guillemots, razor-bills, puffins, kittiwake gulls, and oyster catchers, and also to black guillemots, stormy petrels and fulmar petrels, which have been observed in pairs on the Craig but have not yet nested there, although they have nested on the neighbouring mainland. Protection was not recommended for solan geese or gannets, the stock of which is sufficiently large, nor for the greater black-backed gulls, lesser black-backed gulls, herring gulls, and cormorants, which are so numerous all around our coasts and so destructive to fish and other life as not to merit protection. Regarding the practice of shooting birds from boats, the reporters agreed with the Secretary of State for Scotland that prohibition could not be enforced. The practice, however, should be discouraged. The comparatively few eggs collected by the tenants on the island has no effect on the bird life. The report was adopted for submission to the Scottish Office.

Peterhead Sealers and Whalers

IN the January-February number of the *Scottish Naturalist*, No. 199, 1933, Dr. Robert W. Gray continues his very interesting account of "Peterhead Sealers and Whalers: A Contribution to the History of the Whaling Industry", begun in 1932 (September-October). Peterhead first sent a whaling vessel to the Greenland Sea (the "Greenland" of the old sealers and whalers, the Spitsbergen Sea, the ocean between Greenland and Spitsbergen) in 1788, and a Greenland whaling ship sailed out of Peterhead for the last time in 1893. Dr. Gray, whose grandfather and father both commanded whaling ships, possesses original log-books containing a large amount of reliable information as to the whaling in the latter portion of this period and has gathered together data from many sources relating to the earlier years, beginning with the tiny *Robert*, the pioneer vessel. Up to the year 1814 the fishery had been pursued generally in the more northerly regions, but after this the boats began to explore southwards. From 1825 the Peterhead ships went mostly to the Davis Straits and the whales of the Greenland sea were left alone for a time. In 1837 the whalers returned to the north and both northern and southern fishing was continued, the northern fishery in some years proving very successful. A great deal is to be learned by reading this article, the present portion going up to the year 1874. In that year, according to the log-book of the *Eclipse* it was an open season, northerly winds prevailed in April, May and June, there was a strong south-westerly drift and the edge of the ice lay far west. The ice was drifting south at the rate of twenty to thirty miles a day, and at the end of the voyage it was estimated that more than 300,000 square miles of ice drifted south out of the Arctic Ocean in three months.

Electrical and Rubber Equipment on the Farm

THE supply of electricity to rural areas is continually extending so that increasing numbers of farmers are interested in this alternative method of lighting their farm buildings and conducting power operations in and around the homestead. In these circumstances a visit to a farm carrying a good equipment of the ordinary machinery as well as a complete electrical installation gives an excellent view of the possibilities. At Rothamsted, a thoroughly up-to-date electrical equipment has been supplied by the General Electrical Co., Ltd., and means are provided for making exact comparisons of electricity and oil as sources of power for farm operations. On June 19 a demonstration of the plant was arranged for a party of experts and farmers. The visitors were conducted round the farm buildings and examined a large number of power operations in progress, the motors ranging from 20 h.p. down to ½ h.p. according to the nature of the work. A very complete and efficient lighting system was demonstrated and electricity was in use for water heating, sterilising, and various other stationary processes. First-hand information with regard to the engineering details and performance of the machinery was also available. A demonstration of a number of uses of rubber on the farm was arranged by the Dunlop Rubber Co., Ltd. Various types of rubber flooring for stables, cowsheds and piggeries were on view. The visitors also examined the performance of heavily laden farm carts equipped with low-pressure rubber tyres and rubber-tyred tractors at work on the arable land.

Scottish Marine Biological Station, Millport

THE Scottish Marine Biological Association's annual report on the work of its laboratory at Millport on the Firth of Clyde, for the year 1931–32, has recently been issued (Glasgow: 185 St. Vincent Street). The Association is to be congratulated on the large measure of success which is attending the important though highly specialised researches upon which its small staff of four is actively engaged. Their work has received high commendation from H.M. Development Commissioners and other interested organisations well qualified to assess its value. Over and above the important work on *Calanus finmarchicus* (see NATURE of June 10, p. 843) which is being done, the results of a considerable number of other researches carried out by the station staff and visiting workers have been published in the course of the year. Chief among these must be mentioned several important memoirs by Miss Marshall, Mr. Orr, and Dr. Nicholls, embodying the results of their researches while members of the Australian Great Barrier Reef Expedition of 1928–29. In common with all other organisations in Great Britain and other countries, the Millport Laboratory has been adversely affected by the present economic depression. The block grant originally voted to it by H.M. Treasury—on condition that a proportional sum be raised independently from other sources—was considerably cut down, and the local contributions fell short of the required amount by fully £100. It is greatly to be hoped that the state of financial stringency which still exists will not be allowed unduly to restrict the activities of this and similar institutions.

Institution of Electrical Engineers' Wiring Regulations

THE booklet on "Regulations for the Electrical Equipment of Buildings" (price 1*s.* net) published by the Institution of Electrical Engineers has proved a great boon to the industry. It replaces many rules and regulations published by supply companies and insurance companies. The ninth edition was published in May 1927 and the tenth edition is in active preparation. The new edition will contain rules relating to electric signs and to the new luminous discharge tube installations. These new rules have been approved by the representatives of those interested and by the Council of the Institution of Electrical Engineers. They deal very thoroughly with possible risks of fire and the precautions necessary to avoid risk of shock. These rules are now issued in advance of the tenth edition in a supplementary booklet. Copies of this supplement can be obtained free of charge, for insertion in existing copies of the Regulations, on application to the Secretary of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2.

Home-Grown Timber in Great Britain, 1930

THE Forestry Commission has issued a small pamphlet on home-grown timber (Report on Census of Production of Home-Grown Timber, 1930. H.M. Stationery Office. Dec. 30, 1932). The object of the pamphlet is to contrast the production or utilisation of timber in Great Britain in 1930 with the amount used in 1924. With this object, schedules were issued to woodland owners who had furnished returns in 1924. The census shows that there has been a falling-off between 1924 and 1930, both in respect of the volume and value of the material produced. As regards volume, there is a difference of 14 per cent, the decline being from 55,985,000 cub. ft. in 1924 to 48,057,000 cub. ft. in 1930. The value of the material utilised has fallen in the same period from £2,036,000 to £1,545,000, representing a reduction of nearly 12 per cent. Prices ruled higher in England than in Scotland or Wales, but were certainly low as a whole, especially for the fine hardwoods such as oak (16*d.* per cub. foot in England with an average for Great Britain of 15*d.*; and 22½*d.* for ash in England with an average of 21*d.* for Great Britain—both for timber of saw-mill size). A little more than one-fourth of the total volume of material produced during 1930 consisted of the three fine hardwoods, oak, beech and ash (a total of 12,934,700 cub. ft.) and the figures demonstrate that the bulk of the fellings of these three valuable species were made in England, where 8,120,900 cub. ft. (out of the 12,934,700 cub. ft.) were cut, of which 6,194,200 cub. ft. were oak. Some of the fellings being made in these English woodlands are of the worst lumbering type—unchecked clear-felling and disposal of all that is saleable, the area being left clogged with rubbish and in a most unsightly state. It may be suggested that the time has arrived when a law prohibiting this type of unchecked lumbering, which has done such extensive harm to forest tracts throughout the globe, is urgently needed.

Cultivated Oaks

SIR OSCAR WARBURG and Mr. E. F. Warburg have published details of the oaks in cultivation in Sir Oscar's garden at Headley, Epsom, and elsewhere in the British Isles ("Oaks in Cultivation in the British Isles", *J. Roy. Hort. Soc.*, **58**, Pt. 1, pp. 176–189, Feb. 1933). The account is copiously illustrated with many clear photographs of herbarium specimens and the various species of the genera *Lithocarpus* and *Quercus*, which all come under the general category of 'oaks', are described in detail. Three sub-genera of *Quercus* are recognised—*Cyclobalanopsis*, *Erythrobalanus* and *Lepidobalanus*. A useful list at the end of the article sets forth the common name, the group and the area of origin in non-technical, as well as in botanical, language. Several notes on some South American oaks and garden forms help to clear up difficulties of classification, and a fairly extensive bibliography is added.

A Polish Guide to Zoology

THE Polish Institute for the Promotion of Science and Letters is publishing a "Handbook for Self-Education" (Poradnik dla Samoúkow) under the general editorship of Prof. S. Michalski, and vol. 10 (554 pages), dealing with histology, animal physiology, embryology and comparative animal psychology, has just been issued (Warszawa. Imienia Mianowskiego. 18 zlotys). This is the second section on zoology and contains contributions from Profs. Maziarski, Bialisewicz and Godlewski, whilst Miss Bohn-Drzewina's article on animal psychology, originally written in 1929, is very fittingly appended. The object of this publication is to guide students (and lecturers) in their reading and to direct attention to general principles, to the historical developments and especially to the literature of each branch of the subject. It is not intended to supplant any of the standard textbooks but to supplement them. It is noticeable that the authors are most familiar with German treatises on the various branches of zoology under consideration, but some French and, more rarely, English works are cited and listed in the bibliographies. The work will prove useful to those Polish students who, for any reason, do not enjoy close contact with their lecturers, and it has apparently been compiled with that object in mind.

Veterinary Research in the Union of South Africa

THE eighteenth report of the Director of Veterinary Services and Animal Industry, Onderstepoort, Pretoria, contains matter of value to the veterinarian and agriculturist. Several papers deal with parasitic and virus diseases of animals, and considerable space is devoted to the subjects of mineral deficiency and metabolism and to plants poisonous to stock. Mr. Bedford contributes an exhaustive synoptic check-list and host-list of ectoparasites found on South African mammals, birds, and reptiles, and Mr. Steyn has continued his observations on the effect of sulphur on merino sheep. A ration of 5 gm. of sulphur thrice weekly improves the condition of the sheep and increases the wool yield from an average of 8·4 lb. to an average of 11·625 lb. It also increases resistance to prussic acid, and may be of value in reducing 'geilsiekte', a poisoning that arises from ingestion of certain plants in which a cyanogenetic glycoside is present. The report, in two parts, is admirably produced and illustrated (Government Printer, Pretoria, 20*s.*)

Health of the Navy during 1931

The statistical report of the health of the Navy for the year 1931, by the Medical Director General, Vice-Adm. R. St. G. S. Bond, states that there was an increase in the incidence of disease as compared with the five years' average and with 1930, largely due to an increase in influenza of nearly 2,000 cases. Malaria and venereal diseases declined markedly. Nine cases of undulant fever were reported from the Mediterranean station. It is remarked that undulant fever has increased among Maltese civilians, and in consequence a Government commission is considering the possibility of introducing the compulsory pasteurisation of goats' milk at a central distributing station and the prohibition of retail sales as at present transacted by driving the goats from door to door. Only five cases of enteric fevers were reported.

Index Veterinarius

The first number of the *Index Veterinarius*, covering the indexing done at the Imperial Bureau of Animal Health during the first quarter of 1933, will be issued during the summer. This work will be a complete index to publications relating to veterinary research and public health administration and education. An annual volume, which will be in crown quarto size, will run to about 1,600 pages; and a number, consisting of about 400 pages, will be issued each quarter. About 10,000 references will be indexed each year, each reference being suitably cross-indexed alphabetically both under the names of authors and subjects and, with cross-indexing, there will be about 50,000 insertions in a volume. The price of the *Index* is £4 a volume (four quarterly issues) including postage. Orders should be sent to the Imperial Bureau of Animal Health, Veterinary Laboratory, Ministry of Agriculture and Fisheries, Weybridge, Surrey, England.

Library of the London School of Hygiene and Tropical Medicine

The London School of Hygiene and Tropical Medicine has issued a second edition, compiled by the librarian, Mr. Cyril Barnard, of the "Hand List of Periodicals" contained in the Library on January 31, 1933 (Wightman and Co., Ltd., Dugdale Street, S.E.5. 1*s.* 3*d.*). The arrangement of entries is alphabetical by titles, according to the rules adopted in the "World List", and the "World List" numbers are added to all the periodicals which are contained in that publication. An index of societies and institutions is appended, with the number in the list of the periodicals attached to each entry.

Service for the Blind

The Report of the Librarian of Congress for 1932 witnesses to the effort being made to meet the needs of blind readers in the United States. The number of blind readers who borrowed embossed material during the year was 3,225, and the library collection now contains 24,824 items. An attempt is made to furnish blind readers with the best literature in all fields of knowledge which, on account of the financially unprofitable nature of embossed printing, they have hitherto been unable to obtain. The type of book suitable for transcription is limited, since works the value or attractiveness of which rests largely upon illustrations, are barred. But within the limits, the special accessions, which began with Woodrow Wilson's "George Washington" and contain, on the scientific side, works by Jeans, Maeterlinck, Arthur Keith, Harvey-Gibson, Russell and others, make a notable list of 126 works in Braille and 31 in Moon type.

Preservation of Metallic Objects in Museums

Museum curators are often faced and baffled by the problem of dealing with objects of metal which have deteriorated through exposure, and tend to go from bad to worse when placed on exhibition. They will find a very useful guide to the most satisfactory methods of treatment in a paper by Dr. Alexander Scott in the *Museums Journal* of April (p. 4), where, in addition, hints are given for making brittle substances flexible, for using hydrogen peroxide in restoring degraded flake white to its original colour, for treating foxed prints and removing oil stains.

Collection and Preservation of Animals

The National Museum of Canada has just published a work on "Methods of Collecting and Preserving Vertebrate Animals", which ought to prove useful to travellers and holiday-makers who wish to add to their pleasures that of contributing to the knowledge of their country's fauna (Nat. Mus. Canada, Bulletin No. 69, Biological Series, No. 18, Ottawa, 1932). While less compact and less convenient in size for carrying than the well-known British Museum collectors' handbooks, Mr. R. M. Anderson's book has the advantage of being more thorough in its treatment and of containing a large number of illustrations showing steps in the progress of skinning. In separate chapters it deals with the collecting and skinning of mammals, birds, reptiles, amphibians and fishes, and a special chapter describes the collecting of skeletons. There are 135 pages of descriptive matter, a very complete index of 5 pages, 46 illustrations, and the cost is only 25 cents.

The late Lieut.-Col. A. W. Alcock

In connexion with the obituary notice of the late Lieut.-Col. A. W. Alcock in Nature of April 22, Dr. B. Prashad, of the Zoological Survey of India, states that Col. Alcock's association with the Indian Museum began at the end of the survey season of 1888–89, for with the beginning of the south-west monsoon the surgeon-naturalist used to come every year for the recess period to the Indian Museum, to work out his collections. During the four years of his appointment as the surgeon-naturalist, Alcock spent every recess season in the Indian Museum, and it was during this time and as a result of his association with J. Wood-Mason, then superintendent of the Indian Museum, that Alcock developed his interest in Crustacea. In April 1893, Alcock was appointed officiating superintendent of the Indian Museum, and was confirmed in this appointment in May on the death of Wood-Mason; he held the appointment as professor of zoology in the Medical College of Calcutta as a subsidiary charge. The dates given in the obituary in NATURE, which differ slightly from those quoted by Dr. Prashad, were taken from Col. Alcock's own diary.

Announcements

PROF. R. G. HARRISON, professor of comparative anatomy at Yale University, will deliver the Croonian lecture before the Royal Society on June 29, at 4.30. The title of Prof. Harrison's lecture will be: "The Origin and Development of the Nervous System studied by the Methods of Experimental Embryology".

MR. K. S. KRISHNAN, reader in physics in the University of Dacca, has been elected secretary of the Indian Association for the Cultivation of Science, 210 Bow Bazar Street, Calcutta, in succession to Sir C. V. Raman. Mr. Krishnan has also been appointed the Mahendralal Sircar research professor in physics of the Association.

THE Medical Research Council, acting for the Rockefeller Foundation, has awarded travelling fellowships for the academic year 1933–34 to the following: Mr. H. W. Fullerton, Department of Medicine, University of Aberdeen; Miss M. H. Roscoe, Lister Institute, London; Dr. D. Sheehan, Department of Anatomy, University of Manchester; Dr. S. Zuckerman, Department of Anatomy, University College, London. Dr. Sheehan's fellowship is tenable at Montreal; the others at centres in the United States.

THE annual field meeting of the Association of Economic Biologists will be held on July 14 at the University of Reading. Visits will be made to the University Horticultural Station, the Agricultural Botanic Garden and the National Institute for Research in Dairying. Further information can be obtained from Prof. R. H. Stoughton, The University, Reading.

THE fifty-second annual meeting of the Society of Chemical Industry will be held at Newcastle-on-Tyne on July 10-14, under the presidency of Dr. R. H. Pickard, who has chosen for the title of his presidential address "The Industrial Use of Textiles". Several discussions have been arranged by the various groups of the Society. Further information can be obtained from Mr. J. W. Craggs, 4, St. Nicholas Buildings, Newcastle-on-Tyne, 1.

THE fourth International Congress for Applied Mechanics will be held at Cambridge on July 3–9, 1934. All persons interested in the subject are invited to attend and submit papers. It is suggested that the subjects be grouped as follows: rational mechanics, including vibrations of structures and machines; mechanics of fluids, including turbulence, the boundary layer, heat transfer and compressible fluids; materials, including elasticity, plasticity, fatigue and crystal structure; water waves, including resistance and stability of ships and seaplanes. Further information can be obtained from the Secretary, Fourth International Congress for Applied Mechanics, Engineering Laboratory, Cambridge.

THE prospectus of the German Chemical Plant Exhibition ('Achema VII') to be held in Cologne on May 18–27, 1934, has recently been issued. The annual general meeting of the German Chemical Society and other scientific and technical societies will be held in Cologne at the same time. The preparations which have been made from the point of view of technical organisation in the interests of all those taking part in this Exhibition are fully set forth in the prospectus, a copy of which may be obtained free of charge on application to the 'Dechema', Deutsche Gesellschaft für chemisches Apparatewesen E.V., Achema-Geschäftsstelle, Seelze bei Hannover.

WE have received the first number of a new *Journal of the Chinese Chemical Society*, which is to appear quarterly, the editor being Mr. C. L. Tseng, of the National University of Peking, Peiping, China. This contains several original communications, in English, including studies on Chinese natural products.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An inspector of wireless engineering to the Air Ministry—The Secretary, Air Ministry, Adastral House, Kingsway, London, W.C.1 (June 26). Temporary civil engineering assistants for the Directorate of Works, War Office—The Under-Secretary of State (C.5), War Office, London, S.W.1 (June 28). A city engineer and surveyor of the City of Bradford—The Town Clerk, Town Clerk's Office, Bradford (July 1). A woman assistant chiefly in organic and inorganic work at the Air Ministry, Kidbrooke—The Secretary (I.E.2), Air Ministry, London, W.C.2 (June 30). A technical assistant on the scientific staff of the Fishery Board for Scotland—The Secretary, Fishery Board for Scotland, 101, George Street, Edinburgh, 2 (July 5). A University reader in zoology at Birkbeck College—The Academic Registrar, University of London, S.W.7 (July 10). An assistant curator of the Royal Albert Memorial Museum, Exeter—The Town Clerk (July 12). A teacher of machine drawing, electricity and mathematics at the Chatham Junior Technical School—The District Education Officer, 15, New Road Avenue, Chatham. A head of the Physics Department of the Swansea Municipal Technical College—The Director of Education, Education Offices, Dynevor Place, Swansea.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Electron Polarisation?

SOME years ago I published, in collaboration with Mr. H. Jones[1], a paper in the course of which certain experimental observations were recorded on electrons which had passed through hydrogen gas and had suffered therein two inelastic collisions. Certain arguments were based on these observations from which a determination of the probability of effective collision was obtained. In some very recent work in this laboratory, I have been attempting to use the same method in the case of helium, using apparatus of a very much more refined character. Briefly, narrow electron beams are used of velocities between 50 and 400 volts which pass through helium at low pressure making elastic and inelastic collisions on the way. The beam can be oriented at various angles with respect to fine slits through which, at the zero angle, the beam passes. After the beam has passed through the slits, they enter a magnetic field at right angles to their path, are deflected through 180°, and are then recorded photographically on a film. The film on development shows a magnetic spectrum, exhibiting not only the full velocity line (*F* in Fig. 1) corresponding to those electrons which have proceeded straight through the slits from the gun or have suffered only elastic collisions on the way, but also at lower velocities various narrow lines corresponding to energy losses, the most probable of which I have previously shown to be that corresponding to the transition $1^1S_0 - 2^1P_1$. This loss line (L_1) is quite intense and the probability of a collision of the type necessary to produce this loss has been accurately measured in this laboratory at various impact energies.

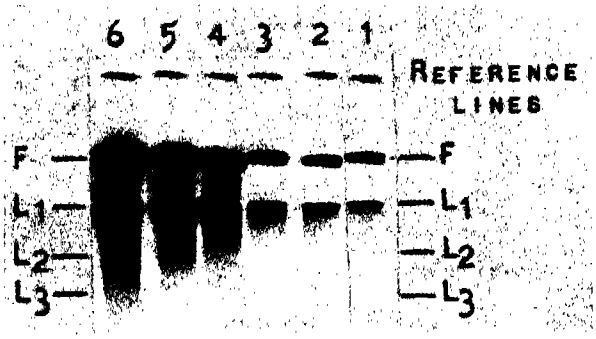

FIG. 1. Magnetic spectra of 300 volt electrons making inelastic impacts in helium. Second inelastic collisions occur only with small probability.

It occurred to me to try to obtain, by lengthening the time of exposure, a mark on the film corresponding to two collisions of this kind. I refer to this line on the film as L_2. It appears to be difficult to get it. At zero angle the probability of its production—that is to say as measured by the ratio of the intensities L_2/L_1 corrected, of course, for the disparity of the paths of the *F* and L_1 electrons—is much less than the corresponding ratio L_1/F. Very careful observations have been taken in order to eliminate all possible experimental 'snags', but there is no doubt that at zero angle and at velocities of several hundred volts the effect occurs. At the same time, it is a striking fact that the L_3 loss corresponding to three collisions is obtainable, and in fact the probability L_3/L_2 is much greater than is to be expected from a simple point of view.

The experiment has been extended from zero angle and it appears that the L_2 loss at three or four hundred volts reaches a maximum intensity at three or four degrees, but at thirty degrees is entirely absent in spite of the very high intensity of L_1.

These are remarkable facts and one explanation which suggests itself, with due diffidence in view of the smallness of relativity spin on the quantum theory, is that the inelastically scattered electrons from helium are polarised. It seems clear that they are in some manner different from the original electrons which leave the electron gun, for had they been precisely similar the probability of a further inelastic collision would have been precisely the same.

I propose to extend these observations to larger angles than thirty degrees and to gases other than helium.

Some results are shown in Fig. 1. There are twelve different exposures on this film, the six lines at the top having been taken with a smaller magnetic field to serve the purpose of reference lines for intensity measurement. The six spectra shown below are of increasing times of exposure from right to left. The absence of L_2 is to be noted (though it is just visible in 5)—and the presence of L_3 in 5 and 6. The photographs lose a good deal in reproduction.

The University,
Leeds.
June 12.

R. WHIDDINGTON.

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[1] *Phil. Mag.*, 1928.

Structure of the Molecule of 12-Phosphotungstic Acid

THE structures and formulæ of the heteropoly acids have long been a subject for speculation. In 1929, Pauling[1], on theoretical grounds, proposed a structure for the molecules of the 12-heteropoly acids, which gave the formula of 12-phosphotungstic acid as $H_8[PO_4.W_{12}O_{18}(OH)_{36}]nH_2O$.

The structure of 12-phosphotungstic acid has recently been found in this laboratory by X-ray analysis, using the powder method. The phosphorus atom is at the centre of a regular tetrahedral group of four oxygen atoms, and each tungsten atom is approximately at the centre of a distorted octahedral group of six oxygen atoms. The complex acidic anion is a co-ordinated structure consisting of a central PO_4 group surrounded by twelve WO_6 groups as a shell, linked together by shared oxygen atoms. The arrangement differs from that proposed by Pauling. The complex anion is found by experiment to be $PW_{12}O_{40}^{-3}$, and has the point group symmetry *Td*. The twelve WO_6 octahedra are arranged in four groups. Each group consists of three WO_6 octahedra arranged round a trigonal axis, so that the co-ordinates of the three tungsten atoms are of the type (*a*, *a*, *b*) (*a*, *b*, *a*) (*b*, *a*, *a*), with two co-ordinates equal, referred to the rectangular axes of cubic symmetry, with origin at the centre of the central phosphorus atom.

Fig. 1 shows the arrangement of one group of three WO_6 octahedra relative to the PO_4 tetrahedron. Considering at first only this one group of three octahedra, there is one oxygen shared in common between the three WO_6 octahedra and the central

PO_4 tetrahedron, and each octahedron shares two other oxygens, one with each of its two neighbours. Thus each octahedron has two edges shared, one with each of the two neighbouring octahedra. Four such groups of three octahedra are arranged round the central PO_4 tetrahedron in tetrahedral symmetry, so that each oxygen of the PO_4 tetrahedron is now an oxygen already shared between three WO_6 octahedra.

The complete acidic anion $PW_{12}O_{40}^{-3}$ is shown in a simplified form in Fig. 2. It will be seen that each WO_6 octahedron, besides sharing two oxygens with octahedra in its own group of three, also shares two oxygens with octahedra in other groups. In the complete acidic anion each WO_6 octahedron consists of one oxygen shared between three WO_6 octahedra and one PO_4 tetrahedron, four oxygens shared between two WO_6 octahedra, and one oxygen unshared with other polyhedra. The twelve tungsten atoms lie on a sphere with the most even distribution possible, each tungsten atom being equidistant from four other tungsten atoms.

In the partially dehydrated acid examined, which contained six or seven molecules of water of crystallisation per molecule of acid, these acidic anions pack together with body-centred cubic symmetry, of point group symmetry T_d^3. The edge of the unit cube is 12·14 ± 0·005 A. The water of crystallisation packs in the interstices between the anions. The agreement between observed intensities and those calculated for this structure is good, and proves its correctness.

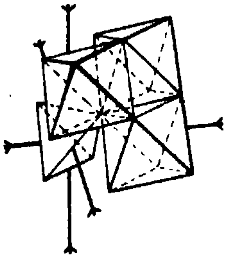

FIG. 1. Arrangement of one group of three WO_6 octahedra relative to the central PO_4 tetrahedron.

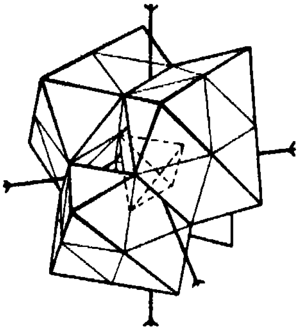

FIG. 2. Complete complex anion, $PW_{12}O_{40}^{-3}$.

This structure gives the formula of the molecule of 12-phosphotungstic acid as $H_3PW_{12}O_{40}$. The formula of the acid is perhaps best written $H_3P(W_3O_{10})_4.nH_2O$, to indicate that the anion is a modified PO_{40}^{-3} tetrahedral group, in which each of the four oxygen atoms has been replaced by a $W_3O_{10}^{-3}$ group, each $W_3O_{10}^{-3}$ group consisting of three WO_6 octahedra sharing oxygens with other octahedra. This formula agrees with the mass of chemical evidence. This work will shortly be published elsewhere in more detail.

It has been proved that the molecule of several other 12-heteropoly acids also have this type of structure, which is apparently the structure for the whole series of the 12-heteropoly acids. This examination of other acids is not yet complete. Work is also in progress on the structures of other hydrates and salts of the heteropoly acids. J. F. KEGGIN.

Physical Laboratories,
University, Manchester.
May 10.

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[1] Pauling, L., *J. Amer. Chem. Soc.*, 2, 51, 2868; 1929.

Bands in the Thermoluminescence Spectrum of Fluorite from Obira, Japan

THE natural thermoluminescence spectrum of almost colourless fluorite from Obira consists of six distinct narrow bands, namely, α_1, α_2, α_3, β_1, β_2 and β_3. Denoting the wave number by ν, it has been confirmed experimentally that $\nu_{\beta_1} - \nu_{\alpha_1}$, $\nu_{\beta_2} - \nu_{\alpha_2}$, $\nu_{\beta_3} - \nu_{\alpha_3}$ are constant, therefore it seems to be plausible to separate the six bands into two groups, α_1, α_2, α_3 and β_1, β_2, β_3. This is indicated in Fig. 1 and the accompanying table. From these results the energy levels assumed in the fluorite phosphor are as shown in Fig. 2.

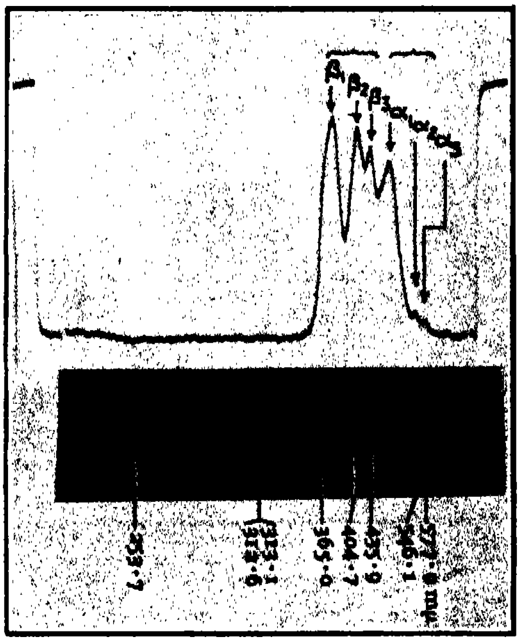

FIG. 1. Above, photometric curve of natural thermoluminescence spectrum. Below, spectrum of natural thermoluminescence and of mercury.

α-group	λ(mμ)	ν (cm.⁻¹)	β-group	λ(mμ)	ν (cm.⁻¹)
α_1	478	20900	β_1	380	26300
α_2	542	18500	β_2	420	23800
α_3	574	17400	β_3	436	22900

$$\Delta\nu_1 = \nu_{\beta_1} - \nu_{\alpha_1} = 5400$$
$$\Delta\nu_2 = \nu_{\beta_2} - \nu_{\alpha_2} = 5300$$
$$\Delta\nu_3 = \nu_{\beta_3} - \nu_{\alpha_3} = 5500$$
$$\Delta\nu \text{ mean} = 5400$$

When the specimen was heated until all natural thermoluminescence disappeared and then irradiated by X-rays (from a Coolidge tube with a molybdenum anticathode, working at 10 milliamperes and 40 kilovolts), it gives, as will be seen in Fig. 3, the thermoluminescence spectrum, the wave-lengths of which coincide with those of the natural thermoluminescence. A comparison of the two photometric curves reproduced in Figs. 1 and 3 shows, however, that there is a remarkable change in the relative intensities of the bands; in the natural thermoluminescence the intensity of the α-group bands is weaker than that of the β-group, while in the restored thermoluminescence the former is definitely stronger than the latter. Further, in each group the longer the wave-length of the band, the weaker the intensity, and this relation remains always unchanged.

The specimen treated with X-rays to restore its thermoluminescent power, emits, when heated, the bands belonging to the α-group at temperatures lower than 200° C. On the other hand, the bands belonging to the β-group are emitted only when the temperatures exceed 200° C. Thus we can separate these two groups thermally.

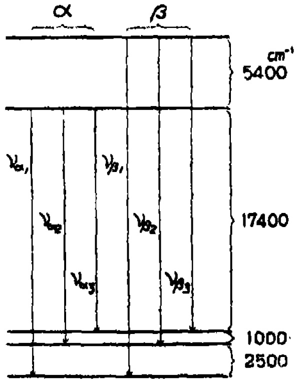

FIG. 2.

It is also of interest to note that the oxides of rare earths extracted from this specimen were proved to be colourless and extremely small (0·004 per cent) in amount.

Similar investigations were carried out on several other specimens of fluorite, but such regular results as the above have not so far been obtained.

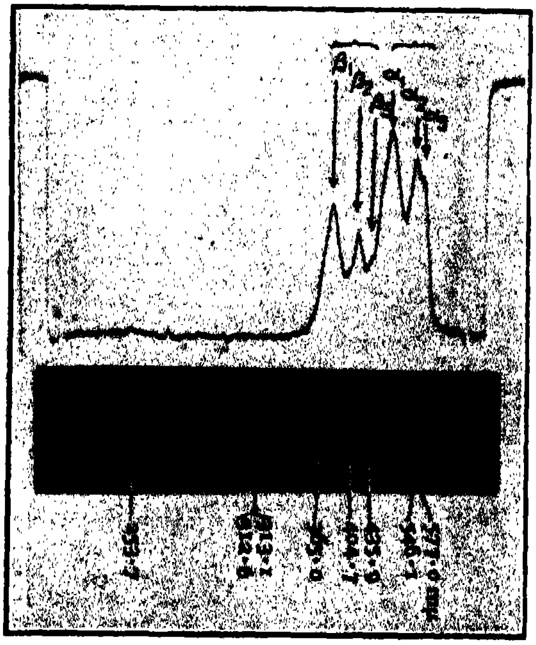

FIG. 3.—Above, photometric curve of thermoluminescence spectrum restored by exposure to X-rays. Below, spectrum of restored thermoluminescence and of mercury.

EI-ICHI IWASE.

Institute of Physical and
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March 10.

Form and Vibrational Frequencies of the Nitrogen Dioxide Molecule

MESSRS. HARRIS, BENEDICT AND KING in a recent letter[1] have criticised our deductions and experimental data for nitrogen dioxide. They raise points of general interest which therefore merit reply.

We would first point out that our work on the structure of triatomic molecules has led to certain conclusions which apparently make it possible to predict the normal structure of such molecules. It seems that if the electrons available for molecular binding are insufficient to occupy the necessary molecular properfunctions, as they are in the case of an odd molecule, the structure of the latter is probably that of the next higher molecule, and with the addition of electrons this structure opens out[2]. Thus water (H_2O) and chlorine monoxide (Cl_2O) have a vertical angle in the neighbourhood of 90°, but chlorine dioxide (ClO_2) is like sulphur dioxide (SO_2) with 120° for this angle. If this rule holds, nitrogen dioxide (NO_2) will be like carbon dioxide (CO_2) and the nitrite ion in aqueous solution, which are rectilinear.

It is difficult to know what is the structure proposed by our critics. If by slightly bent, they mean a vertical angle of, say, 170°, we think this an unlikely equilibrium condition, having little mechanical significance. On the other hand, if the value suggested is near 120°, there would be no difficulty in perceiving the second fundamental frequency assumed by them but actually missing from the observed spectrum.

We would emphasise that the proper place to look for the fundamental frequencies of the ground state of any molecule is where they occur, that is, in the infra-red spectrum. It seems to us that to select frequency differences from the ultra-violet, and then to adjust the infra-red spectrum to suit, is the inverse of the correct procedure, and leads to incorrect results as in the well-known case of chlorine dioxide[3]. It is by this method, however, that Harris, Benedict and King assume the fundamental frequencies of 751 cm.$^{-1}$ and 1321 cm.$^{-1}$; as these authors have only examined the infra-red spectrum between 1 and 4 μ, whereas our results extend to 18 μ, they have still less justification for their assumptions and criticisms. By the courtesy of Prof. T. M. Lowry, we have been privileged to see a proof of the results of Sutherland's recent examination of the spectra of NO_2 and N_2O_4: in agreement with our measurements, the first of these frequencies is present in N_2O_4, but disappears completely in NO_2; the second is missing from our spectrum, but is shown by Sutherland to be due to formation of sodium nitrite on the rocksalt windows in the cases where it has been recognised. Since a strong band does exist at 641 cm.$^{-1}$, it is better to take this as a fundamental frequency, particularly since Harris, Benedict and King admit that all their bands can be accounted for by our assignments.

These investigators also apply certain deductions of Gerhard and Dennison to show that the intensity of an expected *Q* branch is small. On further reading, they will see that the work cited deals with the symmetrical rotator, and has no connexion with the present case. If the molecule were like sulphur dioxide or chlorine dioxide, the *Q* branch would be very powerful.

The complex spectra observed in the ultra-violet may be due to other easily excited electronic states, and since the frequency differences observed do not occur in the infra-red, they must be so. Furthermore, if nitrogen dioxide (NO_2) loses its odd electron it will have the sulphur dioxide (SO_2) structure with the obtuse vertical angle.

Finally, we fail completely to understand why the term 'molecule' should not be applied to N_2O_4. To attribute the existence of this substance to a "short-lived partnership" between two NO_2 groups is contrary to the chemical and physical stability of the molecule, which leads and has a life altogether different from such physically stable and spectroscopically well recognised molecules as OH, CH_2, etc. The underlying assumption of the authors leads to the undoubtedly erroneous statement that all the frequencies of NO_2 appear in N_2O_4. With the formation of a new molecule we have new fundamental modes of vibration, and new frequencies.

C. R. BAILEY.
A. B. D. CASSIE.

University College,
London, W.C.1.
May 3.

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[1] NATURE, 131, 621, April 29, 1933.

[2] Cassie, NATURE, 131, 438, March 25, 1933.

[3] Bailey and Cassie, *Proc. Roy. Soc.*, A, 137, 622.

RECENTLY Bailey and Cassie[1] have reported observations on the infra-red absorption spectrum of the gas mixture of NO_2 and N_2O_4. Harris, Benedict and King[2] have directed attention to the fact that the results of Bailey and Cassie are, in some respects, not in agreement with their observations and the results of previous investigators.

Bailey and Cassie obtained a spectrum for this gas with absorption bands at 15·6, 13·4, 7·92, 6·17, 5·75, 3·22 and 2·91 μ at room temperature, and report the disappearance of all the bands except those at 6·17 and 15·6 μ at a temperature of 100° C.

The infra-red absorption of this gas in the range 2 μ to 16 μ has been investigated by me. Bands were found at 15·6, 13·3, 7·85, 7·28, 6·14, 5·7, 3·89 and 3·3 μ at room temperature. These bands were then examined at temperatures ranging from 3° C. to 150° C. The bands at 3·89, 5·7, 7·85 and 13·3 μ were decreased in intensity as the temperature was increased and disappeared entirely at 150° C. They are therefore attributed to N_2O_4. The bands at 3·3, 6·14, 7·28 and 15·6 μ remained at the higher temperatures and were decreased in intensity as the temperature was lowered, and are therefore ascribed to NO_2. These experiments were carried out with considerable care and the results can be stated with some degree of certainty.

If the bands at 7·28 μ (ν_1 = 1373 cm.$^{-1}$), 15·6 μ (ν_2 = 641 cm.$^{-1}$), 6·14 μ (ν_3 = 1628 cm.$^{-1}$) are taken as the fundamental frequencies of the NO_2 molecule, the 3·3 μ band can be accounted for as the overtone, $\nu_1 + \nu_3$. This selection of frequencies is consistent with an obtuse isosceles triangular structure with an apex angle of about 115°, when the bonds between the N-atom and the respective O-atoms are assumed to be equal. The spectrometer used did not permit resolution of any of the bands into rotational fine structure, and therefore no definite conclusions regarding the structure of the NO_2 molecule can be derived from these observations.

These results are somewhat in agreement with those obtained by Harris, Benedict and King from the absorption spectra of this gas in the visible and ultra-violet, and substantiate their argument that the structure of the NO_2 molecule is not linear. The frequency, ν_1, which they give as 1321·1 cm.$^{-1}$ probably corresponds to the band at 7·28 μ (1373 cm.$^{-1}$) observed by the author in the infra-red. This band, as predicted by Harris, Benedict and King, is less intense than the other two fundamentals, and apparently was not observed by Bailey and Cassie. However, it does not appear probable that the frequency at 751·1 cm.$^{-1}$, which Harris, Benedict and King assign to ν_2, the deformation frequency, is a fundamental of NO_2, since the infra-red band at 13·3 μ corresponding to this frequency is due to N_2O_4 and is not present in the spectrum of NO_2.

From these considerations it appears very likely that the fundamental frequencies of the NO_2 molecule are 641, 1373 and 1628 cm.$^{-1}$.

Details of the above results will be published elsewhere.

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Dept. of Physics,
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Cincinnati, Ohio, U.S.A.
May 11.

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[1] Bailey and Cassie, NATURE, 131, 239, Feb. 18, 1933.

[2] Harris, Benedict and King, NATURE, 131, 621, April 29, 1933.

Crystal Structure of Vitamin B_1 and of Adenine Hydrochloride

CRYSTALS of vitamin B_1 (hydrochloride) from various sources have been examined. All have been found to be substantially identical in form and X-ray patterns. A very slight difference in optical properties may, however, point to the existence of a variable amount of impurity in solid solution. The angle between the *c* axis and the principal direction γ is 19° 40′ ± 20′, 19° 20′ ± 20′, 19° 20′ ± 20′ and 19° 0′ ± 20′ in four specimens prepared respectively by Windaus and Tschesche, Jansen and Donath, and Peters (two specimens separated at different *p*H). The crystals were monoclinic, tabular on *b* and slightly elongated along *c*, showing faces (010), (110), (011), and sometimes (1 KT) and (2 KT). The cell dimensions are: a = 12·62 A.; b = 20·53 A.; c = 6·96 A.; β = 66° 5′. The space group is probably $C_{2h}^5 - P2_{1/a}$ Assuming four asymmetric molecules per cell and the measured density 1·43, the molecular weight is 358, in good agreement with 355 calculated from the formula of Windaus[1], $C_{12}H_{18}O_2N_4S$, 2HCl. The optical properties are: optic axial plane *b*, γ is 19° 20′ from *c* in acute angle; optic axial angle large, undetermined, sign probably negative, birefringence high.

Combining the indications, it is possible to form some idea of the size and shape of the molecule. The molecules must be flat, of dimensions some 8 A. × 10 A., suggesting conjugated ring structure; they must be nearly in (20$\bar{1}$) planes and form a double layer parallel to (010). The intensities of (020)*m*, (040)*m*, (060)*st* show that the heavy atoms S, Cl do not both lie at the ends of the molecule. Beyond that it is impossible to go at present, but if alternative chemical formulæ could be prepared, there exists enough X-ray data to discriminate between them.

As mentioned in recent letters to NATURE[2], there is a close resemblance between the crystals of vitamin B_4 prepared by Peters, and adenine hydrochloride. This has been fully confirmed by our crystallographic investigations. In external form and optical properties the two crystals are identical. The only difference that could be detected was that the B_4 crystals, of which not more than 0·01 mgm. was available, appeared slightly inhomogeneous, one component possibly differing from the others, and from adenine hydrochloride by at most 0·3 per cent in spacings.

The crystals were monoclinic, tabular on *c* and slightly elongated along *b*, showing faces (001), (100), (011) and (110). The cell dimensions are $a = 8{\cdot}71 \pm 0{\cdot}015$ A.; $b = 4{\cdot}80 \pm 0{\cdot}005$ A.; $c = 20{\cdot}00 \pm 0{\cdot}05$ A.; $\beta = 62° 0'$. There are four molecules of the hydrochloride and two of water per cell. The space group is probably $C_{2h}^4 - P2/c$. It may, however, be $C_s^2 - Pc$, as some crystals seem hemihedral, though there is no trace of pyroelectricity. In either case the molecules are asymmetric. The optical properties are: optic axial plane *b*, γ is 8° from *c* in obtuse angle; optic axial angle medium; sign positive; high birefringence. This is a typical structure for condensed ring molecules arranged in two layers with their principal directions nearly parallel to the *c* axis, and their ring planes inclined 30°–40° out of the (100) planes.

This investigation would seem to suggest that the substance showing B_4 activity can only exist as an impurity in the crystals prepared by Peters. There are three possibilities:

(*a*) The impurity is in the form of an amorphous material adsorbed on the crystals, or if it is in solid solution it must either:

(*b*) be present in extremely minute quantities; or

(*c*) itself be a substance closely allied to adenine hydrochloride.

J. D. BERNAL.
D. CROWFOOT.

Dept. of Mineralogy and Petrology,
Cambridge.
May 24.

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[1] A. Windaus, R. Tschesche and H. Ruhkopf, *Nach. Ges. Wiss. Göttingen*, 342; 1932.

[2] R. D. Heard, H. W. Kinnersley, J. R. O'Brien, R. A. Peters and V. Reader, NATURE, **131**, 617, April 29, 1933. R. Tschesche, *Ber.*, **66**, 581; 1933.

Mitogenetic Radiation of Nerve

IN his paper entitled "The Physical Nature of the Nerve Impulse" published in the Supplement to NATURE of April 8, Prof. A. V. Hill has criticised a series of papers on mitogenetic radiation which have appeared from my laboratory. Although my name is not mentioned, I wish to reply as I bear complete responsibility for the whole series.

My first remark refers to Prof. Hill's description of our technique. He confines himself to the method of checking the effect—counting the cells—whereas the investigations described in the papers of Kalendaroff and Braines, quoted by Prof. Hill, had been made solely by the mycetokrit method, the experimental and control yeast suspensions being centrifuged in calibrated tubes (mycetokrites), that is, by a method analogous to the so-called hæmatokrit. The detailed description of this method given by both authors was accompanied by photographs illustrating a successful experiment. The same method had been also partially used by Schamarina. This omission by Prof. Hill is, to my mind, of great importance, because if in the case of counting the cells one might suspect the investigator of being subjective, not doubting his *bona fides*, then the subjective moment in the results with mycetokrit would mean open-eyed falsification of the experiment. The results described in the papers quoted had actually been based on a large number of experiments (approximately 1,200 by Kalendaroff, 400 by Braines, 100 by Schamarina).

My second correction would be the following. Only two papers out of four were mentioned by Prof. Hill, whereas two others have been passed over in silence. How is this silence to be understood? If Prof. Hill did not object to them, then at least one of the papers criticised—that of Kalendaroff—was rehabilitated, because both those unmentioned contain nerve radiation spectra nearly identical to those described by Kalendaroff. If, on the contrary, Prof. Hill did not consider them trustworthy, then he certainly should not have missed the opportunity of utilising them to convince the reader that our work was fantastic.

Let us pass now to Prof. Hill's remark about Schamarina's paper. The argument: "When two impulses start at opposite ends of the nerve they meet in the middle and stop, but again the whole of the nerve has gone through the active phase. If radiation is given out as the result of nerve activity, its emission should occur equally in the two cases" seemed to Prof. Hill quite indisputable, whereas neither Schamarina nor any other author ever stated that there existed or had been proved a simple constant relation between the nerve disturbance and radiation; that is, that the excitation and the chemical processes in the nerves should always be followed by radiation which could be detected by our means. On the contrary, in different passages of Kalendaroff's paper, as well as in my introduction, there was pointed out the unexplained fact that different spectra which had to be considered as elementary (such as glycolysis, action of phosphatase, etc.) only appeared partly in the nerve radiation. A most striking example of this kind was the indication made by Kalendaroff of the absence of the glycolytic spectrum between the electrodes, where the disintegration of sugar no doubt occurred, perhaps even in a higher degree. From the above it follows only that our data and in particular those given by Schamarina contain some facts not yet explained. It may be considered as a commonplace, that with each discovery bringing explanations of the hitherto unexplained, new problems, sometimes more complicated ones, arise. Even the alternative: "If the results are true, we need a new picture of the propagated disturbance in the nerve" put forward by Prof. Hill, is not to be feared. There is no reason why this picture should remain unaltered or its substitution by a new one bring disaster on science.

My last remark concerns Braines's paper on the disappearance of blood radiation after fatigue. It is not quite clear whether Prof. Hill doubts the existence of blood radiation itself. Blood radiation as a constant phenomenon has been proved by a number of German and Italian workers. What seemed most strange to Prof. Hill was the fact that "After seven hours' work the girls were completely exhausted", but this conclusion has been created by the author himself. Braines said nothing of "the girls being completely exhausted"; indeed, in his abstract he pointed out that his method for testing fatigue was available for work of moderate difficulty, by which he emphasised that such was his estimation of his chief results (109 experiments).

The case of sixteen hours' work had been treated separately and gave different results.

Prof. Hill's final remark, about radiation from the eyes, might remain undiscussed, but for a possible misunderstanding which might arise from his statement that "The girls apparently had only to look at the yeast cells to set them dividing". Actually, a duration of two minutes with intermittent excitation had been necessary, which means a radiation dose presenting a considerable value on the mitogenetic scale (see my monograph). Radiation emitted by the cornea had been proved heretofore by different investigators of my laboratory in many hundreds of experiments.

A. GURWITSCH.

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Leningrad.
May 5.

Pelvic Filaments of Lepidosiren

IN Mr. G. E. H. Foxon's opinion[1] the experiments which we made in Marajó are insufficient to prove that the function of the pelvic filaments of Lepidosiren is to emit oxygen, although he fully admits that our evidence proves that oxygen was given out by the filaments when the fish bearing them was placed in deoxygenated water. He considers that it is more probable that under natural conditions the filaments are concerned with the respiration of the parent.

Mr. Foxon's first argument is that the eggs are scattered at random in a single layer over the floor of the breeding burrow and that the smooth surface of the egg-shells makes it physically impossible for them to be piled up in a heap round which the parent could be coiled up. Dr. Carter, who saw the nests himself in Paraguay, states that they are made of dead leaves and grass, collected by the parent and taken into the burrow, and that among these plant materials the eggs are laid. He also states that the male which guards the nest is found coiled round the mass of leaves and eggs in an expansion at the end of the burrow. In Marajó, nests were brought to us each consisting of a mass of weed and plant debris within which the eggs were contained. The fishermen who brought our specimens informed us that the nests were taken from the end of the burrow, and we found that the eggs in them were alive and developing. Our evidence from the Amazonian region is thus in agreement with that of Dr. Carter from Paraguay.

Mr. Foxon's second argument is that repeated visits to the surface, which would have to be made if the male were in any way a means of supplying oxygen to the young, would be seriously detrimental to the welfare both of the male and of the offspring; to the former because the filaments might be bitten off by an enemy, to the latter because, in the absence of the male, enemies might enter the nest and devour eggs and young. He concludes therefore that the male remains in the nest and respires by means of the filaments. He regards the filaments as a means of diminishing the need of frequent absences of the male from the nest.

Mr. Foxon omits to discuss or even to mention the question whether there is enough oxygen in the water in the burrow to provide for the respiration of the male through the filaments, or even any oxygen at all, and the other essential question, that of the respiration of the larvæ. Carter and Beadle found from their experimental researches in Paraguay that there was scarcely ever a measurable amount of oxygen in the water at the bottom of the swamp at the season and in the region in which the nests of Lepidosiren were made, that the water in the nest-burrows would therefore contain scarcely any oxygen or none at all, unless a supply was obtained from the parent fish. In Marajó we made no special investigation of the oxygen content of the water at the bottom of the swamp where Lepidosiren nests were found. The few tests we made of water from the bottom of shallow swamp-pools gave from 0·39 to 0·95 c.c. oxygen per litre. On the other hand, we often used water which had been deoxygenated by enclosing a small fish in it to the exclusion of air, and the average amount of oxygen left at the death of the fish was 1·5 c.c. per litre. It is certain from all the evidence we have, that the water in the nest-burrow of Lepidosiren is much below this, if not actually zero.

Carter found that the larvæ kept their external gills for 45 days after hatching and therefore probably remained in the nest for that period. Additional oxygen could not be obtained from the water outside the burrow, and the only possible conclusion is that if the male did not visit the surface at frequent intervals to fill its lungs with air, both it and the larvæ would die of asphyxia in a much shorter period than 45 days, or even 45 hours.

The conditions in the experiments carried out by us in Marajó were essentially similar to the natural conditions to which the male Lepidosiren and the larvæ are subjected in the nest-burrow. The male in the burrow is free to visit the surface at the necessary intervals, while the male in our experiments could inspire at will. The male in our experiments gave off oxygen from its vascular filaments to deoxygenated water in a glass tube, the male in the nest-burrow with air in its lungs must necessarily give off oxygen to the water in the burrow, which contains less oxygen per litre than the water in our tubes.

J. T. CUNNINGHAM.

Chiswick, W.4.

D. M. REID.

Science Schools,
Harrow.
June 2.

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[1] NATURE, 131, 732, May 20, 1933.

IN the last paragraph of their letter, Messrs. Cunningham and Reid state, "The male in the burrow is free to visit the surface at the necessary intervals . . ." This is what I deny. The male is not free to visit the surface but must remain on guard over the young. All who have collected Lepidosiren material agree that the male *guards* the offspring. Prof. Agar[1] has written: "The eggs are placed at the end of the burrow, and the male lies in the passage leading to it, ready to defend his home with his powerful teeth—as I proved unintentionally on my own person, by putting my hand into a burrow from which I thought that the male had been driven out. I quickly drew it out again with my little finger cut open." In the next sentence, Prof. Agar continues: "The devotion of the male lungfish is truly admirable, for he stays in the nest the whole time, from the moment the eggs are laid till the young are ready to leave the nest, a period of about seven weeks."

With regard to the amount of oxygen in the swamp water, it was found both by Prof. Graham Kerr and by Dr. Carter[2] that eggs and larvæ lived satisfactorily and continued their development when kept in pots and in holes in the ground, both of which were filled with swamp water; no means of supplying oxygen to this water was found necessary, so it must be that the amount of oxygen in the swamp water is enough to supply the needs of the young Lepidosirens. In this connexion I am not disposed to regard as final the estimations of the oxygen present in the swamp waters of the Chaco as determined by Dr. Carter and Mr. Beadle, for Mr. Beadle[3] has since shown that these figures are subject to a correction which may be so great as 1 c.c. of oxygen per litre.

G. E. H. FOXON.

Department of Zoology,
University of Glasgow.
June 10.

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[1] *Proc. Roy. Phil. Soc. Glasgow*, 1909.
[2] *Proc. Roy. Phil. Soc. Glasgow*, 1928.
[3] *J. Linn. Soc. Zool.*, **38**, 258; 1932.

Magnetic Quenching of Tellurium Fluorescence

THEORETICAL considerations on magnetic quenching of iodine fluorescence have been given by Van Vleck[1]. His theory explains the effect as the breaking down of a selection rule (which forbids the radiationless dissociation), in the vicinity of the state represented on the Franck-Condon diagram as the crossing of a stable and an unstable curve.

A similar effect was investigated in this work for visible resonance series of tellurium (Te_2). The potential curves of Te_2 are not known very exactly but the works of Heil[2] and Hirschlaff[3] permitted the inference that there exist possibly conditions necessary for magnetic quenching. Moreover, the comparatively large atomic weight suggested that the spin-orbit interaction might appear sufficiently strongly to be the deciding factor between stable and unstable states. The resemblance of tellurium to other elements of the sixth column of the periodic classification suggested the possibility of ascribing the visible resonance series to $^3\Sigma - {}^3\Sigma$ transitions.

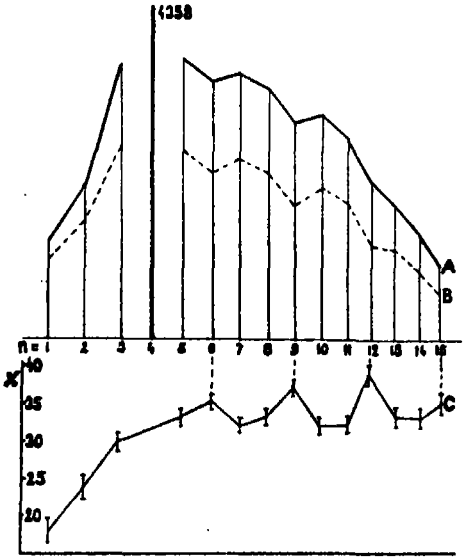

FIG. 1. Curves B and A represent the distribution of intensity in the series of λ4358 in a field of 26,000 gauss and in its absence respectively. Curve C indicates the percentage of quenching and the short vertical lines the probable error of its determination. For n see formula (1).

The electromagnet used in that work gave, in the volume occupied by the tube, a field up to 28,000 gauss. Special arrangements—a detailed description will appear later—made it possible to obtain various pressures and temperatures, the vapour being mostly superheated. The fluorescence was excited with the mercury lines λλ 4358 and 4046, and its intensity found with a Moll microphotometer.

The clearest results were obtained with vapour at saturation pressure for a temperature of 480°–520° C., and superheated to 620° C. The times of exposure were not longer than two hours, which assured a good stability of temperature. The differences of intensity for two exposures in identical conditions were found experimentally to be smaller than 1–2 per cent. The resonance series[4] of λ 4358:

$$\nu = 23{,}930 - 250{\cdot}4n + 0{\cdot}53n^2 \quad . \; . \; . \quad (1)$$

was measured for 11 Stokes and 3 anti-Stokes lines. The quenching in a field of 26,000 gauss amounted to about 35 per cent, and as is seen from Fig. 1, was smaller for anti-Stokes lines than for Stokes lines. The second, fifth, eighth and eleventh Stokes lines (n = 6, 9, 12, 15) which in an unperturbed series have weaker intensity than the mean intensity of their neighbouring lines, were more quenched (35–39 per cent) than the others (32–33 per cent). Neither result is in accord with the supposition that only the excited state is influenced by the field. The quenching of the resonance series of λ 4046 was measured only for the second and fourth lines and amounted to 15 per cent. Other lines were too weak to be investigated or were reabsorbed.

The magnetic quenching of fluorescence, hitherto known for iodine alone and now established for tellurium, indicates the existence of a more complicated mechanism of the effect than had been supposed.

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May 12.

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[1] J. H. Van Vleck, *Phys. Rev.*, **40**, 544; 1932.
[2] O. Heil, *Z. Phys.*, **74**, 18; 1932.
[3] E. Hirschlaff, *Z. Phys.*, **75**, 315; 1932.
[4] B. Rosen, *Z. Phys.*, **43**, 69; 1927.

Number 60 in Time Measurements

WITH reference to the note in NATURE of March 4, p. 299, may I point out that the cycle of 60 years does not appear to date back before the Han dynasty (say 200 B.C.), and that the cycle of 60 before that date only occurs in the actual records as applied to days, probably back to about 2000 B.C. There are traces of a 10-day period in the ritual records and this may predate the 60-day period. T. Fergusson considered the 60-years period to have been borrowed from India and to be the cycle of conjunctions of Jupiter and Saturn in the same geocentric longitude, but beyond the fact that Szuma ch'ien used some queer foreign names for the years of the 60 cycle, there is no real evidence.

HERBERT CHATLEY.

Whangpoo Conservancy Board,
Shanghai.
April 25.

Research Items

Vai Script. The results of an investigation of the origin of the script of the Vai people of West Africa is recorded by A. Klingenheim in *Africa*, vol. 6, pt. 2. The existence of the Vai script was first reported by F. E. Forbes, a naval officer, in the middle of the nineteenth century. S. W. Koelle, a German missionary, who published an account of the Vai language in 1854, met a native, Momoru Doalu Bukere, who claimed to have invented the script as the result of a dream. European scholars have attributed Vai signs to an origin in European letters, arbitrarily selected to represent syllabic values. Sir Harry Johnston detected Arab influence. Others follow Koelle in recognising the pictorial character of certain signs. Dr. Momolu Massaquoi, a member of the Vai people, is of the opinion that they used a few rude signs expressing concepts before a syllabary was introduced. Other scripts of such a type are found in West Africa. No documents of this character now exist among the Vai, as they were probably written on perishable material. Bukere's invention would appear to have been the substitution of the phonetic syllabary for the older pictorial system then probably in a state of transition. The syllabary possesses two classes of signs: (1) original signs, which go back to a particular picture; (2) derived signs, that is, derived from the original signs by the use of diacritical marks. Among the original signs are representations of particular people, people performing certain actions, spirits, parts of the body, animals and plants, objects of material culture, and symbols for abstract concepts. A special interest of the script lies in the fact that it expresses nuances of pronunciation, and refinements which the study of African linguistics has shown to be essential, while giving an African people's own view of their phonetics.

Yuman Ethnology. The University of California for some years past has had in progress a programme of research on the Yuman family, a distinctive block of tribes of some importance living around the head of the Gulf of California, which previously had been neglected in anthropology. Mr. E. W. Gifford, in contributing a unit element on the Cocopa, a tribe who lived on the Lower Colorado (*Univ. Calif. Pub. Amer. Arch. and Ethnol.*, **31**, No. 5) to these studies, outlines the principal results which have been obtained by the work of the last ten years. The total Yuman territory falls into four natural tracts, each forming a region of distinctive geographical features, each inhabited by a group of tribes whose culture was roughly uniform. So far as known at present the languages fall into groups, corresponding fairly closely to the cultural and geographical divisions. The first group, called by the Spaniards Cochina, held the desert central part and a considerable part of the southern portion of the Californian peninsula. So far as known, they are extinct and merged in the Mexican population. Knowledge of them depends upon documentary evidence. The second area is mountainous and desert, comprising the northern end of the peninsula and a strip of the southern edge of the American State of California. This is the area of the Digueño. The third region is the flood-plain valley of the Colorado from about Needles to the mouth of the river, in which was a string of specialised tribes dependent *mainly on agriculture*—Mohave, Halchidhoma, Yuman proper, Kohuana, Halyikwamai and Cocopa with the Maricopa. East of the Colorado the fourth group of the Yuma held most of north-west Arizona. These were the Yavapai, Walapai and Havasupai. The culture of the Cocopa, the subject of Mr. Gifford's study, is on the same basic pattern as in the other great Colorado river tribes, Mohave and Yuma, although enmity between them was chronic.

Antimony Poisoning from Enamelled Vessels. The Ministry of Health has issued a leaflet (Mem. 171/Med.) on the occurrence of three extensive outbreaks of antimony poisoning due to the use of enamelled vessels, fortunately without fatal results. Acid drinks were prepared in the vessels, in one case from 'lemonade crystals' which contained tartaric acid, in the two other instances from fresh lemons. Antimony oxide is widely used, in the place of tin oxide, as an opacifying agent in the enamelling of hardware of inferior quality on account of its comparative cheapness. The vessels in which the lemonade had been prepared in these outbreaks were examined and it was found that the enamel coating had been attacked and disintegrated by the acid, and the lemonade contained a quantity of antimony in solution.

Crystalline Style in Gastropods. In a paper (Reports, Great Barrier Reef Exped., vol. 1, No. 10, 1932) in which C. M. Yonge describes the feeding and digestion in the gastropod molluscs *Pterocera* and *Vermetus*, a list is given of the genera of gastropods in which crystalline styles are known to occur. In this list are stated the habitat, the feeding mechanisms, the nature of the food and the character of the style sac—whether it is in free or in restricted communication with the intestine or is separate from the latter. Of the forty-one genera in the list, seventeen are marine, four are found in brackish water, seventeen in fresh water, two are amphibious and one (*Pomatias*) is terrestrial, largely subterranean. The general conclusion is reached that in the Gastropoda the style is restricted to herbivorous feeders but is not present in all of these. It is confined to those which feed by ciliary mechanisms or by the slow but almost continuous action of a radula. The style assists in the passage of a continuous stream of finely divided food through the gut, and in the effective mixing of food and enzymes in the stomach; by its slow dissolution in the stomach it is admirably fitted for the liberation continuously of very small quantities of enzyme. The different relations between the style sac and the intestine are regarded as correlated with the habits of the respective animals and not as having a taxonomic significance.

Plant Virus Research. An up-to-date account by Dr. Kenneth N. Smith of the present status of plant virus research, together with an extensive bibliography, is given in *Biological Reviews* (vol. 8, p. 136). A perusal of the review gives the general reader an insight into the difficulties which confront the workers in this field. In the first place, the physical properties of the different viruses are by no means uniform. The thermal death points vary from 80° to 90° C. for tobacco mosaic to 42° C. for spotted wilt of tomato, and whereas the former can withstand diluting to 1 in 10^4, the potato mosaic group are inactivated by quite a small dilution. Further, some viruses retain their infective power *in vitro* for a year or more, while others become innocuous after a storage period of hours only. Of special interest is the section dealing with recovery, carrying power, resistance and immunity. Some authentic cases of recovery are recorded, but the plants were susceptible to reinfection with the same virus. Resistance to a specific virus has been found among individuals of a species or among certain varieties of a plant normally susceptible to that virus, but no development of immunity has been demonstrated. As regards immunological reactions of tobacco mosaic virus, separate antisera are produced in rabbits to normal sap from healthy tobacco plants and to virus sap from mosaic plants. Appropriate quantities of the antiserum to the virus sap completely inactivate the virus sap in this case. Emphasis is laid on the importance of classifying the virus rather than the disease it causes, as hitherto too much stress has been laid on symptomatology alone.

Geology of Rangoon. In his report on "The Geology and Underground Water of Rangoon" (Government Printing Office, Rangoon, 1932, pp. 78, with geological and other maps and sections), Mr. P. Leicester presents the results of a detailed geological investigation of the origin, distribution and behaviour of the underground water which supplies the needs of Rangoon; and makes a series of recommendations for its conservation and future exploitation. Special attention is directed towards the prevention of influx of saline water from the river and the associated deltaic deposits. The work involved the making of a geological map of the area, and this in turn has yielded evidence of oscillations in the levels of land and sea during the Quaternary, comparable with those experienced in Europe during the glacial periods. The rising of the geo-anticline of the ridge that terminates at the Shwe Dagon Pagoda was followed by a fall in sea-level of 250–300 ft., corresponding to the lowering of sea-level of 40 fathoms over the Sunda Shelf described by Molengraaff. Fluctuating recoveries are noted, due perhaps to alternating retreat and advance of the ice-caps. More recently there have been uplifts of the land, witnessed by the formation of denudation terraces, while the latest changes of all are referred to a slight rise in sea-level followed by slight uplifts related to the still growing geo-anticline. These recent movements, marked by earthquakes, appear to take place along fault planes on the western limb of the anticline of the Dagon ridge.

Ice in the Weddell Sea. Tabular icebergs of twenty miles or more in length have been noted from time to time by various antarctic expeditions, but in recent years their number seems to have increased in the Weddell Sea and the South Atlantic, especially the Scotia Sea. In an article in the *Geographical Journal* for May, Mr. J. M. Wordie and Dr. Stanley Kemp discuss recent records of these bergs and their significance. Treating reports by trading vessels of large bergs with commendable caution and confining their arguments chiefly to reports from whalers and expedition ships, the authors conclude that the unusual number of these bergs indicates some exceptional occurrence in the Weddell Sea. On the eastern side, Coats Land, excepting the Stancomb Wills promontory, would not be likely to yield many huge bergs since it seems to rise into high land not far from the sea. The Stancomb Wills promontory could not account for all these bergs even if it had completely broken up, as is possible. The Filchner or Weddell barrier at the south of the sea is certainly in an unstable state but is relatively low and these huge bergs are very lofty. There remains only the unknown south-western side of the Weddell Sea, which on account of heavy pack-ice has never been approached. Messrs. Wordie and Kemp suggest that these bergs come from that coast and indicate extensive changes in that region and the loss of thousands of square miles of barrier ice. These changes may have considerably improved the chances of penetrating that unknown quarter.

Eddy Diffusion. The mathematical treatment of eddy diffusion in the atmosphere demands a knowledge of analytical methods not possessed by the majority of meteorologists, including professional meteorologists. This is unfortunate in view of the great importance of eddy diffusion in many meteorological problems, for example, those involving the transference of heat, moisture, and dust particles, to mention a few. A number of papers dealing with these problems have been written by Taylor, Chapman, and others in Great Britain. The latest work on the subject, by O. F. T. Roberts, of the University of Aberdeen (*Mem. Roy. Met. Soc.*, 4, No. 37), deserves the attention of those interested in the subject. In it the author starts with the hypothesis that the density distribution due to scattering satisfies a functional equation expressing uniformity of scattering power, and shows that from this it can be deduced that the square of the standard deviation of matter scattered from a plane source varies as the time. The method followed in reaching this conclusion is extended so as to show the manner in which this density distribution may differ from that due to the assumption of an eddy scatter analogous to that which arises from thermal diffusion in a solid body. A similar result for homogeneous scattering in three dimensions is derived by further analysis, and finally the scatter from a fixed point or line into a medium with uniform mean flow.

Penetrating Rays from Thunderclouds. Schonland and Viljoen (*Proc. Roy. Soc.*, May) have looked for a connexion between South African thunderstorms and the discharges of a Geiger-Müller counter shielded with iron. The counter discharges and the abrupt electric field changes due to lightning discharges were recorded side by side on a chronograph tape, and special care was taken to ensure that no spurious coincidences were produced by the mutual influence of the recording amplifiers. A statistical analysis of the records showed that for some storms there was a pronounced probability of a counter impulse coinciding with a lightning discharge. A further examination reveals that the probability of counter impulses is slightly increased in the few seconds which precede a flash. None of these effects was observed with storms distant less than 30 km. from the station—with nearer storms there was apparently a reduced probability of counts during the time when the strongly charged cloud was overhead, in agreement with earlier work of Schonland. The upward projection of 'runaway electrons' in the intense electric fields of thunderclouds has been suggested by Wilson. These electrons may be deflected in the earth's magnetic field and produce the results now discovered.

Fluorescence of Zinc Oxide. An investigation by Beutel and Kutzelnigg (*Sitzungsber. Wien. Akad. Wiss.*, 141, 437; 1932) shows that the fluorescence of zinc oxide preparations is a specific property and is not due to traces of foreign metals as impurities. The effect is diminished by powdering the preparation, and the colour of the light is affected by the temperature to which the oxide has been heated. An intensive green fluorescence is obtained with preparations ignited in a reducing atmosphere, whilst the oxide obtained by decomposing the carbonate at 300° shows a dark brown fluorescence. A minimum of fluorescence strength was found with preparations heated at 600°, and the effect disappears when oxide obtained by heating the nitrate is strongly ignited. No definite relation between physical properties and fluorescence could be established.

Copper Age in Ancient China. Further analysis (cf. NATURE, 131, 243; 1933) of three ancient halberds similar to those found on the Yin site at Honan, made by Tsurumatsu Dono (*Bull. Chem. Soc. Japan*, April), showed that one was almost spectroscopically free from tin, another contained only 0·60 per cent of tin, whilst the third contained 2·19 per cent. In the first, 15 per cent of lead was present, in the second 0·58 per cent and in the third 5·85 per cent. Arsenic was either absent or present only as a trace. Since the three objects were almost identical in appearance, it is concluded that the introduction of bronze poor in tin occurred in a transitional period which came between the copper and bronze ages and that this period was very short. The paper contains complete chemical analyses and microphotographs of structure. The close similarity in composition between ancient Chinese and Sumerian bronzes is noteworthy.

Astronomical Topics

Radial Velocities of Variable Stars. Dr. P. W. Merrill contributes an article on this subject to *Popular Astronomy* for April. He refers to the former idea that these were dwarf stars approaching extinction; a study of their proper motions showed that the variables are in most cases remote, so that they are now reckoned as giants, not as dwarfs. The radial velocities are important for giving an estimate of their true speeds, since the thwart velocities are generally too small to determine accurately. It has been observed in many cases that the bright lines visible at maximum show a velocity of approach of about 15 km./sec. relatively to the dark lines. It is concluded in the article that the latter give the true speed of the star, and that the difference arises from an outward motion of heated gases. A strong argument for this is afforded by the close double star *X* Ophiuchi; one component is variable, the other of constant light; at maximum the spectrum of the former is observable, at minimum that of the latter; the dark lines in both stars give the same radial velocity, −70¾ km./sec., while the bright lines in the variable give −83½. A similar argument is drawn from *R* Aquarii and its companion nebula. In some faint variables the bright lines only are measurable. A correction is applied to these to deduce the true velocity of the star. A statistical study then shows that the variables, as a whole, have a mean speed of 37 km./sec. relatively to the other stars, this speed being towards a point in the southern hemisphere nearly opposite the solar apex.

Microphotometry of the Solar Spectrum from 4040 to 4390 A. In the first part of a recent paper (*Annals Solar Physics Observ., Camb.*, 3, Part 2), Dr. R. v. d. R. Woolley develops the mathematical theory, following Eddington's earlier investigations, of the occurrence and the relative intensities of the dark lines in the solar spectrum, on the hypothesis of selective scattering in the sun's atmosphere. The modification of the scattering coefficient due to the Doppler effect is also considered. The observations described in the second part are based on plates recently taken by Evershed at Ewhurst. A plate was cut in two; one half was exposed by Evershed, the other half was standardised photometrically at Cambridge, the two halves being afterwards developed together. The spectrograms were then examined with the Cambridge microphotometer. The tables give the multiplet identification, the central intensity and equivalent breadth of the lines in the part of the spectrum examined. In the third part, Dr. Woolley gives a full discussion of multiplet intensities, the calibration of Rowland's scale of intensities and the classification of solar lines according to contour.

Publications of the U.S. Naval Observatory (Washington). Vol. 13, of 365 pages, of these Publications, contains the observed positions of sun, moon, planets and stars, obtained from observations with the 9-in. transit-circle. The observations of the sun extend from 1918 until 1925, those of the moon from 1913 until 1925. The results are compared with the predictions of the American Ephemeris; in the case of the moon there is a further comparison with an improved ephemeris, in which some corrections to Brown's tables have been applied. In the case of Mars, Ross's corrections to Newcomb were introduced into the ephemeris in 1922, but their effects have been carried back to 1913.

The next item in the volume is a catalogue of 9,989 standard and intermediary stars, between the north pole and declination −36°; they were observed in the years 1913–1926; the positions are reduced without proper motion to 1920. Proper motions have been determined for all the stars. They are given to three or four decimals of a second of time, and to two or three of a second of arc. There follows a catalogue of 2,438 standard stars, and a comparison of the observed positions with those of Greenwich, Boss and Eichelberger.

Full details are given of the methods of observation. The transits were recorded by hand-tapping the passage over fixed wires. Meridian marks were used as a check of the azimuth of the instrument. A diagram shows an interesting correlation between the changes of azimuth of the marks and the motion of the pole determined from the observations for latitude variation. A printing chronograph was used for recording the transits, the times for each wire being read to 0·02 sec.

Nature of Dental Caries

IN a recent paper on the cause and nature of dental caries, J. J. Enright, H. E. Friesell and M. O. Trescher describe experiments designed to elucidate the part played by local factors in the etiology of this disease (*J. Dental Res.*, 12, 759; 1932). The authors first discuss the two chief theories of causation and point out that Miller's bacterio-chemical theory does not explain all the facts. For example, carious areas produced artificially by acid have not simulated natural caries in certain particulars; the carious process may halt for indefinite periods and, finally, dirty mouths are frequently free from caries. After a review of the relation of diet to dental caries, the authors conclude that improper diet is at least an important predisposing factor in the causation of tooth decay, since diets rich in vitamins A, C and D and yielding an alkaline ash, when utilised systematically during the period of development, produce teeth less liable to decay. After eruption, the structure of the enamel cannot be changed by factors acting from the pulp, because there is no circulation in this structure. Moreover, the ameloblasts, the enamel-forming cells, are lost at the time of eruption.

Clinical observation shows that caries begins at the surface of the tooth and only at certain parts of the surface, namely, in pits and fissures, and on the buccal, labial and proximal surfaces near the gum. It does not commence in areas which are scoured by the food during mastication.

In their first experiments, the authors investigated the action of lactic and citric acids at different *p*H values upon the enamel of isolated teeth *in vitro*. They found that artificial caries might simulate natural caries exactly, that all solutions between *p*H 4 and 8 etched enamel and that different enamels varied in their susceptibility to the action of the acids. Further experiments were carried out with the same solutions to which tricalcium phosphate had been added to saturation, since saliva is supersaturated with regard to this salt. It was then found that etching of enamel only occurred in solutions more acid than *p*H 5. It was also noticed that incipient carious areas were insoluble in acid, apparently because they contained an increased amount of organic material: it is suggested that this explains why the natural process often comes to a stop, even when acid-producing bacteria are contiguous to the lesion.

In the authors' second series of experiments, cultures were taken from carious areas and from similar regions in the mouths of persons immune to caries and grown on blood agar and acid galactose-whey broth. Another examination of the same mouths was made 3–9 months after the first: a close correlation was found between the presence of lactobacilli on the first occasion and the advance or development of caries in the interval. The strains of lactobacilli obtained could be divided into two chief groups: Group 1 usually produces a smooth colony and acid without gas in glucose, galactose, levulose, maltose, lactose, sucrose, mannitol, sorbitol, dextrin and salicin, but no acid or gas in raffinose, arabinose, xylose or inulin. Organisms of this group grow at 15° C. and are agglutinated by a Group 1 rabbit antiserum. Group 2 usually produces a rough, fuzzy type of colony, and acid in glucose, galactose, levulose, maltose, lactose, sucrose and raffinose. This type may or may not produce acid in dextrin; it usually does not produce acid or gas in arabinose, xylose, mannitol, sorbitol, salicin or inulin. Strains of this type do not grow at 15° C. and are not agglutinated by Group 1 antiserum. Lactobacilli of intestinal origin can also be divided into two similar groups. The strains of Group 1 were the most commonly found in the mouth.

The evidence adduced in this paper confirms the view that caries is directly due to the growth of lactobacilli in the mouth, the acid produced decalcifying the enamel. Growth of the organisms and close contact of the acid with the teeth are favoured by the presence of food débris in their pits and fissures and between them. The authors state that tests on the results of reducing the number of organisms in the mouth are now in progress and will be reported later.

Fishery Research in Newfoundland

FOLLOWING upon a preliminary survey of the Newfoundland fishing situation and a report on it to the Empire Marketing Board and to the Newfoundland Government, a scheme providing for a five-year period of fishery research in Newfoundland was drawn up. Half the cost of installation and subsequent maintenance of the Laboratory is, by agreement, borne by each of these two bodies. The objects of the scheme are the investigation of the life-histories of the principal commercial fishes with the view of gaining a clearer understanding of their movements and natural fluctuations, and the improvement of some or all of the existing methods of processing and marketing of the fish and fish products. By-products and their possible utilisation also come within the scope of the investigations.

The Laboratory is situated in the outport of Bay Bulls, some 18 miles south of St. John's. It is housed in part of certain spacious fishery premises which, fortunately, were available for this purpose. The buildings are fronted by wharves standing in water up to 20 ft. deep, so that steam trawlers can berth hard by the laboratory premises. Thus situated, right by the water's edge in an active fishing centre, and in the closest juxtaposition with a commercial concern, the Bay Bulls Laboratory appears to enjoy unique facilities for prosecuting fishery research—opportunities which it shows every indication of utilising to the full.

The scheme came into operation on April 1, 1931, and a report[*] upon the Laboratory's first full year's work has now been published, the main object of which is to indicate the general trend and progress of the various researches already under way.

In accordance with the scheme, the work of the Laboratory follows two main lines which may for convenience be termed (*a*) biological and (*b*) applied.

[*] Reports of the Newfoundland Fishery Research Commission. Vol. 1, No. 4: Annual Report for 1931. (St. John's, Newfoundland: Newfoundland Fishery Research Commission, 1932.) 1 dollar,

In the biological investigations the aim has been, during the first year, to make a rapid survey of the marine fauna and its inter-relationships in the waters supporting or directly connected with the fishing activities of Newfoundland. Much work has already been accomplished, and great strides are being made in piecing together the life-histories of the caplin, salmon, Newfoundland herring, haddock, cod, lobster, shrimps and prawns. Particular attention has been given to the short-finned squid (*Illex illecebrosa*), a highly important animal commercially in that it is the staple bait for the fall cod fishery. If it does not arrive in very large numbers, this fishery is a failure and up to one-third of the year's catch is lost. In 1930 and 1931, for example, Newfoundland was bereft of much of its fall fishery owing to shortage of this squid for bait.

In addition to the above, extensive hydrographical observations have also been carried out, the results of which already show that the Newfoundland area is one where contrasting, as well as rapidly changing, physical conditions of sea-water have a profound influence on the fauna.

On the processing or applied side, investigations are being carried out on the properties of Newfoundland cod liver oil from the point of view of marketing possibilities. The processing of dried codfish, bacterial infection of fish products, and preparation of fish meals, fish glue, and soaps from many sources are also receiving attention.

The report closes with some conclusions and recommendations which might well be adopted by the various firms and departments concerned in the improvement of the Newfoundland fisheries ; and in an appendix there is published a very useful "First List of Fishes in the Newfoundland Fishing Area".

Judging from the contents of this report and some technical papers already issued, there can be little doubt that the Director and staff of the Bay Bulls Laboratory are attacking with great vigour and remarkable success the numerous problems with which they are confronted.

South-Eastern Union of Scientific Societies

THE thirty-eighth annual congress of the South-Eastern Union of Scientific Societies was held at Norwich on June 7–10 under the presidency of Prof. E. J. Salisbury, Quain professor of botany at University College, London. The occasion was the first time that the Union has met for its congress in the extreme north of its area, and the attendance was well up to the average.

Prof. Salisbury's presidential address on "The Influence of Man on Vegetation" showed that there are two sides to man's interference with the native flora, elimination and introduction. The relative biological isolation of the British Isles ceased when human intercourse between Great Britain and the Continent began. The idea is prevalent that the chalk downs of the south-east were grassland from time immemorial, but the grounds for this assumption appear quite inadequate. Chalk hills are not unsuited for tree-growth. Neolithic man cultivated even the crests of the hills, and the chalk may have been the nursery of English agriculture. Stress was laid on man as an unconscious agent in dispersal. The rôle of man in this respect has been neglected. Dispersal by birds seems a legitimate subject for examination, but the seeds of plants carried by man in the mud of his feet and his clothes have not received sufficient attention.

After the depauperisation of the British flora during the Glacial period, neolithic man must have brought seeds of weeds with his flax and corn in the absence of all modern screening methods. Calculations show that of the 288,857 cwt. of clover and grass seed imported in 1912, 2–6 billion weed-seeds from abroad were sown in Great Britain. The unconscious carrying of seeds by man was strikingly illustrated by an experiment on the dust collected in sweeping out the pews of two selected churches. Samples of the dust were sown, each sample being about four ounces in weight. The germinating plants in any one sample varied from one to fourteen, about 90 per cent being grasses. Possibly clothed in skins, neolithic man may have carried seeds for considerable distances, even as now Prof. Salisbury finds that man is carrying about viable seeds in his turned-up trousers after a walk on Chesil Beach or on a Hertfordshire common. In the latter case, a walk produced 110 grasses and three dicotyledons.

In a paper by Mr. Hugh Ramage on "Applications of the Spectroscope to Biology" some of the results of research by this means were given. Strontium was detected in the genital duct of the edible snail and manganese was a prominent element in its liver. It was found that, on examining 146 specimens, copper and iron were always present. The highest concentration of silver was found in the liver and kidney of *Pinna pectinata*. Silver was present in every liver of crabs and lobsters examined. Cæsium was always found in the liver of the common scallop. Examination of sea-water always revealed 0·004–0·005 per cent of strontium, which appears to place strontium as the ninth element in order of abundance. Copper was found in all human tissues and occurs in greatest concentration in fœtal tissues and fœtal livers. Rubidium occurs in the heart and striated muscles. Silver appears to be a normal constituent of the thyroid and the tonsil. The edible mushroom yielded copper and silver. Some fungi contain rubidium. The highest percentage of rubidium (dry weight) was found in *Cantharellus cibarius*, namely, 0·21 ; and of silver, 0·20 in the skin of a specimen of *Psaliota campestris*.

Investigations as regards insect immigration have been carried out since the inauguration of the special committee of the South-Eastern Union in 1932, and there are now thirty light-vessels and light-houses with their observers engaged in the work, with some hundreds of inland observers. Useful records have reached Capt. T. Dannreuther and Dr. C. B. Williams, who are responsible for the collating of such records. The Large White butterfly has been observed by L. G. Sharman, of the East Dudgeon light-vessel, for some years. He has seen a stream of these butterflies every year about the middle of June. In 1931 about thirty an hour were seen passing over the ship from east to west. Near Alston, G. Bolam observed a passing band of Small Garden Whites on June 25, 1932. They were steadily pursuing a northerly course at the rate of about a dozen a minute. These are cited as showing the records that it is hoped observers will send in from all parts of the country, with the view of the further elucidation of the immigration problem.

Among the more general papers read at the Congress were "Rural Surveys; Change and Decay and Rebirth" by W. P. D. Stebbing; "Pond-Life, with Special Reference to the Rotifera and Polyzoa", by H. E. Hurrell; "Evolutionary Sequence Amongst Desmids", by Prof. F. E. Fritsch; "The Viking Period", by P. D. Kendrick; "The Relationship of Geology to the Scenery of the Weald", by F. H. Edmunds; and "The Pliocene and Pleistocene Deposits of Norfolk", by J. E. Sainty.

A very full programme of excursions to places of scientific interest was carried out during the Congress. It was announced that the Congress for 1934 will be held at Reading, under the presidency of Prof. H. L. Hawkins, professor of geology in the University of Reading.

University and Educational Intelligence

CAMBRIDGE.—Dr. G. D. H. Bell, of Selwyn College, has been appointed University demonstrator in agricultural biology.

A university demonstratorship in chemistry is vacant. Information concerning it may be obtained from Mr. H. Thirkill, Clare College, to whom applications should be submitted before June 30.

D. Thoday of Trinity College and Dr. F. H. Constable of St. John's College have been approved for the degree of Sc.D.

Dr. K. A. C. Elliott, Beit fellow, has been elected to a fellowship at Selwyn College.

LONDON.—The following degrees have recently been awarded: D.Sc. degree in botany to Mr. C. L. Huskins (King's College) for eight published works on genetics and cyto-genetics; D.Sc. degree in plant physiology to Mr. E. Ashby (Imperial College—Royal College of Science) for nine works, including four papers on "The Interaction of Factors in the Growth of *Lemna*", and two papers on "Studies in the Inheritance of Physiological Characters"; D.Sc. degree in vital statistics to Hilda M. Woods (recognised teacher at the London School of Hygiene and Tropical Medicine) for nine works on medical statistics and epidemiology; D.Sc. degree in zoology to Cherukad Cherian John (Imperial College—Royal College of Science) for a thesis entitled "On the Anatomy, Habits and Development of *Spadella Cephaloptera*" (*Quart. J. Micro. Sci.*, Feb. 1933); D.Sc. degree in chemistry to Mr. A. G. Francis (private study) for four independent publications, entitled (1) "Report on the Investigations carried out by the Experimental Staff of the Departmental Committee on Ethyl Petrol"; (2) "Presence of Barium and Strontium in Natural Brines"; (3) "The Recovery of Radium from Luminous Paint"; (4) "3 : 4-di-*p*-nitrotetraphenylfuran"; together with four conjoint subsidiary contributions.

TO meet the growing demand for biological teaching in schools, a diploma course in biology will shortly be instituted at the University of Leeds, chiefly to meet the needs of teachers qualified in the physical sciences. The course will extend over two years and it is proposed to begin it on October 3. Lectures will be given on one evening a week and Saturday mornings. Further information can be obtained from the Registrar of the University.

ON the recommendation of the Scientific Advisory Committee of the Lady Tata Memorial Fund, the following awards of scholarships, open to graduates of any nationality for research work on diseases of the blood, with special reference to leucæmia, for the academic year 1933–34 have been made: Dr. W. Büngeler, University of Frankfort-on-Main; Dr. L. Dolschansky, University of Berlin; Dr. M. C. G. Israëls, University of Manchester; Dr. C. Oberling, Faculty of Medicine, Paris.

AT a recent council meeting of the Association of University Teachers the position of the recently displaced teachers in German universities was discussed. The Association recorded its continued adherence to the fundamental principle of freedom of opinion and teaching in academic life and stated that it is ready to co-operate in affording facilities at British universities for such displaced teachers, provided that special funds are made available for the purpose. The Executive Committee of the Association appointed a sub-committee to keep in touch with other groups having similar aims, of which the convener is Prof. R. J. Tabor, Imperial College of Science and Technology, South Kensington, London, S.W.7.

WE have received from Armstrong College, Newcastle-upon-Tyne, the report for 1931–32 of the College Standing Committee for Research. This report demonstrates that the researches aided by the Committee's grants, which amounted during the year to £586, are bearing excellent fruit. In addition to giving a list of a hundred publications, the report particularises some results of special interest. A notable addition to the resources of the Physics Department was made possible by a grant of £842 from the Rockefeller Foundation towards the cost of a reflecting echelon interferometer, the research committee undertaking to find the remainder (£300) of the price. An investigation dealing with the use of high-frequency fields to raise body temperatures gave such promising preliminary results that the Medical Research Council made a grant for its continuance. Incorporated in the report are accounts of the work of the Northern Coke Research Committee and the Electrical Engineering Committee of the College.

"The Broad Highway of Soviet Education", as shown to a party of twenty men and women interested in education, is described in a pamphlet recently published by the Society for Cultural Relations between the Peoples of the British Commonwealth and the U.S.S.R. The tour, which took place more than a year ago, included a series of visits and receptions in Leningrad, Moscow, Kharkov (where part of the visit was filmed) and Kiev. The compulsory seven-years school in two stages, 8–12 years and 12–15 years, is said to be based upon correlation with working life. The schools are commonly attached to factories and, so far as possible, all practical work is productive: one of the schools visited was found to be self-supporting. Continued education is provided in technical and factory-apprentice schools for the stage 15–18 years. Higher education is conducted chiefly in single-faculty institutes intended to turn out technical experts in factories, and other specialists.

Qualification for admission generally includes two years' experience of factory life and two or three years of a workers' preparatory course embracing a wide variety of subjects. The writer of the report, Mr. C. A. Harrison, education officer of Messrs. Cadbury Bros., suggests that educational contacts may serve to bridge the gulfs which separate the Soviet system from the rest of the world. He was impressed while in Russia by the apparent prevalence of what he describes as a "wholesome" dread of embroilment in war coupled with a determination to be prepared.

Calendar of Nature Topics

Fourth 'Buchan Cold Spell'.

June 29–July 4. It not infrequently happens that June in England brings an interval of dull weather separating the sunshine of May from the heat of July. In Great Britain at least, the soubriquet of 'flaming June' appears to be a misnomer. On the whole the fluctuations of temperature in June are relatively slight, and the general tendency is for a steady warming up throughout the month without any marked set-backs. At Greenwich the 90-year averages from 1841 to 1930 show that this rise is interrupted by a short period of steady temperatures from June 29 until July 1, but this is too slight to be dignified by the name of a 'cold spell' and there is no reason for supposing that it will be repeated in future years.

Nile Flood

The River Nile is very low during April, May and the early part of June, reaching its minimum at Khartoum about May 11. In June heavy monsoonal rains begin to fall on the mountains of Abyssinia, and throughout July, August and September, immense quantities of water are discharged into the Blue Nile. The main Nile commences to rise rapidly towards the end of June, reaches its maximum level about September 4, and remains high until some time in October. The water fills the irrigation channels and covers much of the flood plain, on which silt is deposited, forming a soil of great fertility. This annual flood is the most important event of the Egyptian year, and river gauges have been maintained since early times to measure its progress and height. Before the building of the great dams, the crops of Egypt were so dependent on the annual flood that the gauge readings were used as a basis for assessing taxation.

Migration and Plumage Coloration of Birds

During the summer months there occur on the mud-flats and sandbanks of northern Holland many wading birds belonging to species which normally should have been at their breeding places in the north of Europe or Asia. A first impression would regard them as immature birds, but G. J. van Oordt has shown that many wear adult summer plumage or some modification of it. On June 23 and 27, 1927, he collected seven knots and fifteen turnstones on the island of Vlieland, and since the very last of the migratory individuals pass through in the end of May or in the first days of June, these were real summering birds (*Tijdschr. Ned. Dierkundige Vereen.*, Ser. 3, 1928, p. 25). Examination showed that the testes of most of the individuals collected were inactive, having formed no spermatocytes, and that although the plumages of such birds varied much, they all possessed in various degrees the feathers of adult summer plumage. Three birds were found to have a relatively large number of spermatocytes and in them the plumage was almost or quite identical with the adult summer phase. From these observations, it would appear that the absence of urge to migrate as well as the failure to replace winter by summer plumage was associated with inactivity of the gonads and that summer plumage in male birds cannot develop until spermatogenesis has started and many spermatocytes have been formed.

Spat-Fall and Shore Populations

In June and July occurs the spat-fall of many shore molluscs, when rock surfaces, seaweeds, and the sand itself begin to be deluged with a rain of minute individuals on the point of settling down after their free-swimming larval life. They are often very small—the shells of recently settled mussels measure about 0·3 mm.—but the number is very great, and this and their rapid growth make them important elements in the shore population. Indeed they have proved to be a nuisance to many coastal towns, for intake pipes have become blocked by the growth of mussels which have settled in them from the passing current. The late Sir William Herdman reckoned that on the seashore about 120,000 mussels might go to the square yard, and Richard Elmhirst finds a similar number on the piles of Keppel Pier at Millport, upon which about 60,000 individuals of the beautiful plumose anemone (*Metridium senile*) also find foothold. At Millport the numbers of the acorn barnacle (*Balanus balanoides*), a crustacean, are still greater. Elmhirst states that in late April the cyprid larvæ may occur 300 to the litre close inshore when swarming in to settle down (*Glasgow Naturalist*, 1932). These small larvæ may settle 200 to the square inch, or more than a quarter of a million a square yard. A heavy mortality, due largely to the molluscs *Purpura* and *Littorina* ensues, so that by autumn they are reduced to 15,000 a square yard. But even the dead ones have contributed to the circulation of organic matter in the shore area.

The Ice Bridge: A Correction

The paragraph under this heading in NATURE for April 15, p. 557, requires some modification. The harbours and waterways of the system of American "Great Lakes" are frozen or blocked by ice, and in Lake Superior ice-fields often extend beyond the range of vision from shore, but in most winters much open water remains, especially in the lower part of Lake Michigan. In February 1904 the lakes were almost completely ice-covered, but this is exceptional.

In many parts of the northern hemisphere the winters of the twentieth century have been generally milder than those of the latter half of the nineteenth, and ice conditions may also have become less severe, but precise information is difficult to obtain, as the greater power of steamers and the extended use of ice-breakers would suffice to keep navigation open longer than formerly. The record of 300 ships held up at one time, which is quoted in the "Gulf of St. Lawrence Pilot", was first published in 1888, and therefore must refer to sailing or low-powered craft, but the actual date of the occurrence cannot now be traced. For the reasons stated, such an occurrence is unlikely to recur.

Societies and Academies

Dublin

Royal Irish Academy, April 24. P. J. Nolan : The influence of condensation nuclei and dust particles on atmospheric ionisation. Fair conformity with Wright's conclusion that dust particles play an important part in the equilibrium of atmospheric ionisation is obtained from a re-examination of previous work. A theoretical basis for the equilibrium equation $q = \zeta n \sqrt{Z}$ is proposed. The combination coefficients of small ions with dust particles and with large ions are deduced. R. F. Scharff : The past wanderings in Europe of two African animals. The manner in which the hippopotamus and the bivalve mollusc *Corbicula* seem to have entered Europe from the south-east in late Pliocene times is described. They probably travelled along the great Rift Valley from Central Africa to Palestine when the Red Sea was still a river valley. The area of the Ægean Sea, while still unsubmerged, afforded an easy passage between Asia Minor and Greece and thus on to Italy and Malta. Their remains occur everywhere in Italy, France and Belgium, but the hippopotamus never crossed the Rhine. Eventually, in the early Pleistocene, both species passed into England, when it was part of the Continent. Special comment is made on the significance of the British distribution of both animals.

Edinburgh

Royal Society, May 15. Norman H. W. Maclaren and Thomas H. Bryce : The early stages in the development of Cavia. A sequel to an earlier memoir by Maclaren. The study was recently resumed in the light of specimens examined in the living state and for more advanced stages of results obtained after intra-vitam staining with trypan blue. A number of blastocysts at earlier stages than those hitherto known are described ; the mode of implantation is re-examined ; the fate of the part of the uterus to the anti-mesometrial side of the site of implantation is demonstrated ; and the significance of the observation that after a preliminary destructive phase the endometrium lining the decidual cavity comes to be packed with maternal cells containing trypan blue granules is discussed. P. F. Kendall and H. Briggs : The formation of rock joints and the cleat of coal. By means of frequency charts for a number of the chief coalfields of Great Britain and the United States, it was shown that the main cleating and jointing system has a north-westerly direction. In some coalfields, such as Yorkshire or Durham, the north-westerly orientation is remarkably consistent ; in others, such as Scotland, it is less definite, though the majority of the values obtained have a north-westerly trend. The authors' records also show that that direction was also maintained over great periods in geological time. The forces responsible for jointing have therefore to be looked for among those incident on the earth's crust down to and including the present time. The Mid and East Lothian coalfields have been specially studied to trace the connexion between cleat and joints and the faults known to exist in that field ; and the effect of faulting on jointing was discussed. The joints and cleat were induced by rapidly alternating torsional stress applied to the earth's crust in a direction approximately parallel with the equator. It is concluded that the alternating torsional stress is due to tidal action, and that the long-continued alternation of stress so applied eventually caused failure of a bed through fatigue. Mary G. Calder : Notes on the Kidston collection of fossil plant slides. (2) The anatomy of the axis of *Bothrodendron mundum* Williamson sp. Certain previously undescribed anatomical features of the aerial stem of *Bothrodendron mundum* are discussed and illustrated. The more important of these are variation in the pith cells, occasional occurrence of marked xylic perforations in the stele, hyphal structure in the middle cortex in certain specimens, and the occurrence in some stems of a ring of cortical tracheidal strands, having no apparent connexion with the outer surface of the stem or with the leaf traces. H. W. Turnbull : Matrices and continued fractions. By the method of matrices it is possible to form the reciprocal of a certain continuant determinant which was first studied by Sylvester. This leads to new expressions for the derivative of a function $f(x)$ as a continued fraction. A series, the nth term of which involves the square of the difference between $f(x)$ and its nth convergent, is discussed. J. L. Gray and Pearl Moshinsky : Studies in genetic psychology (1). Correlation between collateral relatives with respect to intelligence. The correlation with respect to intelligence as measured by the Otis group advanced test for pairs of sibs between the ages of nine and twelve and a half is 0·35 ± 0·05. For pairs of first cousins the coefficient is 0·16 ± 0·06. This investigation, carried out with the same test on children selected in the same way as in Herrman and Hogben's study of twins, establishes the existence of a significant difference between the correlation of fraternal twins and ordinary sibs. The possible existence of sex-linked gene differences with respect to intelligence and the effect of order of birth in the family are also discussed.

Paris

Academy of Sciences, May 8 (*C.R.*, **196**, 1345–1444). A. de La Baume Pluvinel and D. Barbier : The observation of the total eclipse of the sun on August 31, 1932. Observations made at Louiseville, in Canada. Photographic, photometric and spectrographic observations of the corona were made, the results of which are detailed. René Maire, Etienne Foëx and Georges Malençon : The etiology of 'bayoud', a disease of the date palm. A fungus, named *Cylindrophora albedinis*, was isolated from the diseased tissues in 1930 by Maire and Kilian, but no fructification. The mycelium had been met with in the natural state, and attempts at infection were always negative. The formation of intravascular conidia has now been observed and it appears clear that this fungus can be regarded as the agent of 'bayoud'. Some varieties of date palm appear to be resistant to the disease. Frank Schlesinger was elected *Correspondant* for the Section of Astronomy in succession to the late Prof. H. H. Turner. Lucien Chamard : The paratangent of an ensemble equidistant from a point ensemble. G. Ehresmann : A theorem relating to locally projective spaces and its generalisation. Paul Delens : Certain problems relating to Finsler spaces. Arnaud Denjoy : Rectifiable curves. André Fouillade : The iteration of certain linear functional substitutions. Caius Jacob : Some mixed problems in a circular ring. F. Charron : An accelerometer with a rolling contact. Edouard Callandreau : The elastic state of a welded assemblage. Antoine Magnan and Claude Magnan :

A hot wire apparatus for the study of the air movements produced by the flapping wing of a bird or insect. The number of beats per second varied from 17 for the Japanese nightingale to 128 for the humblebee. The records appear to prove that the current of air is continuous and not interrupted at the end of [illegible] beat of the wings, at least in insects. J. Dufay and Ssu-Pin Liau: The absorption of light in interstellar space. From the study of various spectral types of stars, it is shown that there is no statistical relation between the colour indices and the absolute spectroscopic magnitudes, but that there exists an appreciable correlation between colour index and distance. Louis Filliâtre and Pierre Vernotte: The defects of elasticity of metals. The damping of torsion oscillations. Jean Guastalla: Researches on an equation of state for monomolecular films. Emile Sévin: Synthesis of the works of Newton, Fresnel and Maxwell. R. Bossuet: The examination of minerals for the alkali metals. An application of the spectroscopic method described in a previous communication. The rare alkaline metals are found in potash felspars and micas. Contrary to the views of Barbier, but in agreement with the results of W. Vernadsky, rubidium and lithium are found in orthoses and microclines. Thus the method for classifying the potash felspars given by Barbier fails. Marcel Schwob: The dispersion of electrical double refraction of ethyl ether. G. Liandrat: The internal photoelectric effect in liquid dielectrics. René Audubert: The electrochemical properties of electrodes photosensitised with copper salts. René Arditti: Study of the system sulphuric acid, magnesium sulphate, water. W. Graff: Thermal analysis of the system chlorine, boron trichloride. The thermal analysis gave no indication of a new chloride and consequently of no valency of boron higher than three. René Dubrisay and Mlle. Paulette Drouot: Some phenomena of surface chemistry. Desmaroux: The stability of the nitrocelluloses: the distinction between the decomposition due to internal combustion and the decomposition due to saponification. Albert Portevin and Paul Bastien: Contribution to the study of the casting of ternary alloys. F. François: The precipitation of antimony iodide and its hydrolysis. In the presence of sufficient sulphuric acid, potassium iodide precipitates a red iodide of antimony, SbI_3. This is readily hydrolysed to oxyiodide. Pierre Dubois: The action of hydrogen peroxide on permanganate. The substances obtained by this reaction have no fixed composition, varying between $MnO_{1.88}$ and $MnO_{1.93}$. Adrien Karl: The preparation of the metallic tungstates. Tungstic anhydride dissolves readily in fused common salt giving sodium tungstate (readily soluble in water) and chlorine. G. Gire: The thermal decomposition of the magnesium silicides. The magnesium silicide obtained by synthesis at 450° C. is not stable above 500° C.: at 550° C. it decomposes into magnesium and the silicide Mg_3Si_2. M. Tiffeneau, Mlle. Jeanne Lévy and F. Kayser: The unsymmetrical influence exerted by an asymmetric carbon in the action of an organomagnesium compound on an aldehyde function. The preparation of a single diastereoisomer. R. Paul: A molecular transposition accompanying the dehydration of tetrahydrofurfuryl alcohol. Raymond Quelet: The synthesis of the chlormethyl derivatives of *p*-bromanisol and of the nitroanisols. J. Colonge: The generalisation of the method of condensation of ketones by mixed aminomagnesium compounds. Paul Fleury and Raoul Paris: The comparative action of periodic acid on the α- and β-glycerophosphoric acids. P. Carré and D. Libermann: The chlorides of alkylsulphurous acids. M. Chatelet: A pyridine-iodine molecular association. Pyridine forms an unstable molecular compound with iodine with the composition $I_2(C_5H_5N)_2$. Mlle. Madeleine Roy: The alteration in castor oil by heating. The oxygen of the air is the chief cause of alteration of the oil. C. L. Sagui and A. Jourdan: Some data on the genesis of colloidal pyrrhotite and of other minerals in the mine of Bottino. R. Bureau: The rapid variation of atmospherics at sunrise. Jean Chevrier: Magnetic measurements in Syria. L. Eblé: The variation of the horizontal component of the earth's magnetic field round about days of magnetic calm. L. Tuwim: A new method for the direct determination of the natural angular distribution of the cosmic rays. C. T. Popesco: A perennial bean obtained by grafting. Mlle. M. L. Verrier: The static refraction of the eye in the cephalopods. Henri Beauvalet: The experimental study of digestion in selachians. Fontaine and Mme. Boucher-Firly: The alkaline reserve of the blood in fishes. Maurice Rangier: A form of elimination of uric acid. Gaston Menier: The apparatus studied and used at Noisiel since 1875 for lowering the temperature of the air and at the same time freeing it from dust.

Rome

Royal National Academy of the Lincei, Jan 22. F. Enriques: Continuous series composed of rational involutions of groups of points on an algebraic surface. A. Myller: Geodetic conics. F. Tricomi: Determination of the asymptotic value of a certain integral. P. Dienes: The displacement of an n-tuple, and a new interpretation of Ricci's rotation coefficients. G. Krall: Variable parameters and asymptotic provisions in some problems of celestial mechanics. G. Lampariello: The analytical nature of the solutions of canonical systems integrable by quadrature. G. Vranceanu: The geometrical interpretation of mechanical systems. C. Alessandri: The apparent velocity of the surface propagation of earthquakes in relation to the hypocentral depth. The determination of the depth of the hypocentre from time data or, more specifically, from the differences between the times of arrival at different places of a given phase of the longitudinal seismic waves, is considered. An expression is derived which indicates that, in general, the superficial velocity of propagation will appear greater when the depth of the hypocentre is great. Various numerical applications of this result are given. G. Ponte: Volcanic fumaroles. Evidence is cited which renders improbable the general opinion that volcanic eruptions are produced by the elastic force of the gases contained in the magma. So far as it has been carried to the present time, study of the phenomena bearing on fumarolic exhalations indicates that, with the exception of sodium and potassium chlorides—which originate directly from the magma—these exhalations are produced by the action of atmospheric agents on the magma at various temperatures. C. Dei: The sensitivity and the approximation of measurements of the amplification coefficients of triodes. The methods considered are those of Miller, Appleton, and Lo Surdo. G. Eibenschütz: The nature of electrodynamic forces. The possibility of deducing mathematically the production of an electrodynamic force from the movement of electrons in a conductor is demonstrated. R. DE FAZI: The chemical constitution of cholesterol, and a new isomeride of cholesterol. The action of hydrochloric acid on cholesterol under various conditions yields, in addition to the known cholesterol hydrochloride melting at 158°–158·5°, two other hydrochlorides, with melting points 136°–137° and 124°–126°. These have now been converted into isomerides of cholesterol. The structural formulæ of these cholesterols are discussed. P. PRATESI: The action of alkaline hypoiodites on the pyrrolic aldehydes. In their behaviour towards alkaline hypoiodites, the 2- and 3-aldehydo-derivatives of pyrrole exhibit analogy to the ortho- and para-aldehydes of phenol and to the naphthol aldehydes. The pyrrole-3-aldehydes lose the aldehyde group as formic acid, iodine entering the molecule to form the corresponding iodo-derivatives in almost quantitative yield. Pyrrole-2-aldehydes are less stable towards hypoiodites than their 2-isomerides; pyrrole-2-aldehyde itself gives hepta-iododipyrryl. A. QUILICO and A. DI CAPUA: Aspergillin, the spore pigment of *Aspergillus niger* (2). When extracted with dilute ammonia and precipitated with acid, aspergillin forms shining black lumps showing brown reflection and is insoluble in the ordinary organic solvents, except pyridine, although it gives up 12–14 per cent of its weight to methyl or ethyl alcohol. When heated, it behaves similarly to certain oxypyrrole blacks and it always contains a small proportion (about 0·2 per cent) of iron. Elementary analysis gives the ratios C : H : O = 5 : 4 : 2. Its molecule contains a hydroxyl group and methyl, ethyl and other derivatives have been prepared. A. ROSSI: The crystalline structure of the compound $LaAl_4$. This compound crystallises in the dimetric system and cleaves readily along the pinacoid faces (001). For the unit cell the value of a_0 is probably 13·2A. and the ratio $c : a$, 0·77. On the assumption that the unit cell contains 16 molecules, the density is calculated to be 3·69, which agrees moderately well with the pyconometric value, 3·86. The symmetry class is not determinable with certainty. T. LIPPARINI: *Rzehakina epigona* (Rzehak), a foraminifer of archaic type in the Bologna Tortonian. T. CARPANESE: The mineral deposits of Monte Rosso di Verra (Monte Rosa group) (2). Owing to its marked crossed dispersion, its associations with olivine, and the orientation of the two minerals in these associations, the titanolivine of Monte Rosso is more nearly analogous to that of Val Malenco than to the titanolivines and titanohumites of other deposits. The optical properties of the amphibole present indicate that this mineral is a form intermediate to green hornblende and actinolite.

Forthcoming Events

Tuesday, June 27

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Annual General Meeting. Capt. T. A. Joyce: Presidential Address.

Thursday, June 29

ROYAL SOCIETY, at 4.30.—Prof. R. G. Harrison (professor of comparative anatomy at Yale University): "The Origin and Development of the Nervous System studied by the Methods of Experimental Embryology" (Croonian Lecture).

ASSOCIATION OF TECHNICAL INSTITUTIONS, June 29–July 1.—Summer Meeting at the Municipal College of Technology, Manchester. Sir Hugo Hirst: President.

Official Publications Received

GREAT BRITAIN AND IRELAND

Observations made at the Royal Observatory, Greenwich, in the Year 1931, in Astronomy, Magnetism and Meteorology, under the direction of Sir Frank Dyson. Pp. viii + A62 + B7 + Cix + C74 + [illegible] + E49 + 19. (London: H.M. Stationery Office.) 30*s.* net.

Department of Scientific and Industrial Research. Summary [illegible] Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1932. Part 1. With Report of the Geological Survey Board and Report of the Director. Pp. iv + 96. (London: H.M. Stationery Office.) 2*s.* net.

Journal of the Chemical Society. May. Pp. iii + 469–557 + viii. (London: Chemical Society.)

University of Reading: The National Institute for Research in Dairying. Annual Report for the Year ending 31st July, 1932. Pp. 78. (Reading.)

Annals of the Natal Museum. Edited by Dr. Ernest Warren. Vol. 7, Part 2, May. Pp. 145–301 + plates 7–15. (London: Adlard and Son, Ltd.). 17*s.* 6*d.* net.

OTHER COUNTRIES

The Quarterly Journal of the Geological, Mining and Metallurgical Society of India. Edited by K. K. Sen Gupta. Vol. 4, No. 4, December 1932. Pp. 119–174 + plates 9–12. (Calcutta.) 6 rupees.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 72: Varieties of Wheat in Australia; a Catalogue, with Pedigree or Source, and a Genealogical Chart showing the Relationships of the More Important Varieties. By J. R. A. McMillan. Pp. 28. Bulletin No. 73: A Soil Survey of the Nyah, Tresco, Tresco West, Kangaroo Lake (Vic.), and Goodnight (N.S.W.) Settlements. By J. K. Taylor, F. Penman, T. J. Marshall and G. W. Leeper. Pp. 47 + 4 maps. (Melbourne: H. J. Green.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 84, 1932. Pp. iii + 536 + 33 plates. (Philadelphia.) 6.25 dollars.

The Academy of Natural Sciences of Philadelphia. Review of 1932. Pp. 16. (Philadelphia.)

University of California Publications in American Archæology and Ethnology. Vol. 31, No. 6: Ethnology of the Nisenan. By Ralph L. Beals. Pp. iv + 335–410 + plates 40–41. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 70 cents.

Svenska Linné-Sällskapets Årsskrift. Årgång 16, 1933. Pp. v + 154. (Uppsala.)

Bulletin of the American Museum of Natural History. Vol. 67, Article 1: A New Fossil Snake from the Notostylops Beds of Patagonia. By George Gaylord Simpson. Pp. 22. (New York City.)

Mellon Institute of Industrial Research. Bibliographic Series, Sixth Supplement to Bulletin No. 2: A List of the Books, Bulletins, Journal Contributions and Patents by Members of the Mellon Institute of Industrial Research during the Calendar Year 1932. By Lois Heaton Pugsley. Pp. 10. (Pittsburgh, Pa.).

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